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Implementation and Outcomes of Lay Health Worker–led Self-management Interventions for Long-Term Conditions and Prevention: A Systematic Review

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Abstract:	The aim of this study was to systematically review lay health worker (LHW) -led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of their findings taking into consideration the intervention components that have been applied. We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria that were self-management with diabetes (n=29), cardiovascular diseases (n=8), and those at risk of cardiovascular diseases (n=3), consisting of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions. The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects. Keywords: lay health worker, long-term condition, self-management, intervention component, behavior change technique, systematic review

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The aim of this study was to systematically review lay health worker (LHW)-led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of research findings, taking into consideration the intervention components that have been applied.

We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria: self-management with diabetes (n = 29), cardiovascular diseases (n = 8), and those at risk of cardiovascular diseases (n = 3). These consisted of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions.

The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects.

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Introduction

Non-communicable diseases (NCD) are long-term conditions (LTC) that require ongoing self-management over a period of years as individuals learn to manage their health challenges (Eaton, Roberts, & Turner, 2015; Taylor et al., 2014; Nolte & McKee, 2008). The self-management of LTCs has been defined as a daily and flexible process where an individual, as a responsible actor, is able to perform individual goal-driven activities (Lorig & Holman, 2003; Ausili, Masotto, Dall'Ora, Salvini, & Di Mauro, 2014), such as adopting information, drug and symptom management, and adjustment to psychological consequences such as emotions and stress (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002).

Acquiring and applying individual skills related to self-management components demands effort from patients, peers, and health professionals (Kaptein, Fischer, & Scharloo, 2014; Kawi, 2012). People's beliefs that they can cope in their everyday activities and meet the challenges of self-management have been labelled as self-efficacy (Bandura, 1977; Vervekina, Shi, Fuentes-Caceres & Scanlon, 2014). Self-management interventions provide support to modify one's decisions and behavior for a healthier lifestyle. Interventions usually include a variety of observable and replicable behavior change techniques (BCT), such as goal setting, action planning, and self-monitoring (Michie et al., 2013; Duff et al., 2017).

The self-management of LTC has been supported by peers (Tang, Funnell, Gillard, Nwankwo, & Heisler, 2011; Dale, Williams, & Bowyer 2012; CADTH, 2013), who are usually people with the same diagnosis or health condition as the people they assist (Lorig & Holman, 2003; Carr et al., 2011; van Ginneken et al., 2013). Lay health workers (LHW) as LTC self-management supporters are especially able to share values, socioeconomic status or cultural background and, in some cases, also the experience of LTC (South, Meah, Bagnall & Jones, 2013; Hunt, Grant, & Appel, 2011; Islam et al., 2015).

LHWs act as peer supporters, educators, role models, and community capacity builders (South et al., 2013). LHWs have been shown to improve equity in health care services by reaching underserved people with a poorer health status (Walker & Jan, 2005; Shah & Patel, 2013). There has been a wide variety of LHW training in terms of duration and methods (O'Brien, Squires, Bixby, & Larson, 2009; South et al., 2013).

The effectiveness of LTC self-management interventions has been measured through individuals' knowledge, psychological state, behavior, and clinical outcomes (Dube, Van de Broucke, Housiaux, Dhoore, & Rendall-Mkosi, 2015). Lay-led self-management programs for those with chronic conditions may improve short-term self-management outcomes, such as physical activity (PA) and self-efficacy (Foster, Taylor, Eldridge, Ramsay, & Griffiths, 2009). Previous systematic reviews of LHW interventions for diabetes found that (a) LHWs' roles in individuals' self-management counseling were diverse in their ways to support, educate, advocate, and facilitate, and (b) interventions were partially effective in improving HbA1C levels and health behavior outcomes (Hunt et al., 2011; Little, Wang, Castro, Jimenez, & Rosal, 2014). Carr et al. (2011) investigated connections between the implementation of interventions and their outcomes, but found no firm relationships between them.

However, in this study we systematically reviewed previous LHW-led self-management interventions for adults with LTCs in terms of the implementation of interventions. The first objective was to investigate those characteristics of LHWs and their training that have been reported within the context of self-management. The second objective was to investigate the implementation of interventions. The third objective was to investigate what kind of relationships, if any, there are between intervention components and nutrition behavior (NB) and PA outcomes.

Methods

Search strategies and selection criteria

The present review was conducted according to standard systematic review methodology (CRD, 2009) and reported according to the PRISMA Statement (Liberati et al., 2009). A systematic search for articles, reported full text in English (due to limited facilities and resources for translation) and published between 2010 and 2015, was undertaken in five databases between December 2015 and January 2016: Cochrane, MEDLINE, CINAHL, PsycINFO, and Web of Science. Search terms included Community Health Worker* OR Lay health* OR Lay supporter* OR Lay tutor* OR Advisor* OR counsellor* OR counselor* OR peer OR peer counsellor* OR peer counselor* OR peer-advisor* OR peer-coach* OR peer-counsellor* OR peer-counselor* OR peer-educator* OR peer-led* OR health trainer* AND Self-Management OR Self care. Both MeSH and free-text terms were used. The full search strategy is available from the authors on request.

One of the authors extracted the following data independently and discussed it with the other researchers who were involved with study selection. Disagreements between reviewers were resolved by consensus. The following inclusion criteria were applied: adults as recipients; non-communicable and somatic diseases or their prevention; LHW-led self-management intervention; organized by primary health care, community health center or corresponding organization; RCTs and quantitative trials. The exclusion criteria were the following: studies that reported outcomes of LHWs' own self-management; intervention was led by non-trained peer supporter; family interventions; cancer, HIV, asthma or mental health self-management interventions; review papers; study protocols; and papers presenting baseline results only (Figure 1).

All of the included studies deal with self-management of diabetes and cardiovascular diseases. Both diseases, as long-term somatic and non-communicable conditions, can largely be prevented or treated by allied self-management activities covering certain daily behavioral and psychological actions taken by individuals. NB and PA are key self-management activities when dealing with type 2 diabetes and cardiovascular diseases on a daily basis (WHO, 2013; Donaldson & Rutter, 2017). In addition, there is a vital need for research with a scope that combines self-management and prevention in both diabetes and cardiovascular diseases. The quality of the included studies was assessed using the 14-item checklist from the Manual for Quality Scoring of Quantitative Studies with a range of 0–28 points (MQSQ; Kmet, Lee, & Cook, 2004). The quality evaluation was conducted by the first author, and the decisions have also been discussed with two other authors.

Analysis

The analysis of the first and second objectives concerned the contents of LHWs, their training and LHW-led self-management interventions. The interventions' components were classified according to their formats (e.g., group, individual, telephone, home visit), elements (e.g., lectures, PA classes; Davidson et al., 2003), and BCTs (Michie et al., 2013). The data were analyzed using content analysis (Schreier, 2012) by identifying the units of meaning, condensing them and finally creating subcategories. Based on similar subcategories, eight main categories were composed: (1) characteristics of LHWs, (2) training of LHWs, (3) intervention delivery by LHWs, (4) theoretical background and guidelines of the interventions, (5) principles of implementation, (6) intervention formats and elements, (7) behavior change techniques, and (8) intervention management and mediators. (Table 1.)

For the third objective of the review, self-management was investigated as a behavioral outcome of NB and PA in 13 original studies that measured them. The analysis was conducted by identifying the components and clinical measurements and their links to NB and PA. The data within these analyses was relatively narrow, however, it was eventually grouped according to their improvements in NB and PA and those groups were compared. This review describes and identifies the intervention features that indicate participants' behavior changes within the original studies.

All of the following aspects in the fields of NB and PA and clinical measurements were manually coded and categorized in Microsoft Excel: the reported intervention formats and elements, such as delivery in group or individual sessions, telephone or online contact, and education lectures (Davisdon et al., 2003); behavior change techniques (applied by Michie et al., 2013); intervention length and frequency; significantly improved and not improved self-management outcomes in terms of PA and NB; and clinical measurements.

This semi-qualitative metric was developed in the current study to extract and investigate the links between intervention components and PA and NB. Additionally, there were a large variety of measurements used to assess PA, NB, blood lipids, and blood pressure as self-management outcomes, which were difficult to bring together. Therefore, all of the tests that investigated similar items were classified as items of self-management (Table 2) in order to allow the data to be analyzed and for the results to be explained based on the study topic. All of the results are based on the published study results, and no original study data or intervention material have been examined.

Results

Included studies

The included studies (n = 40) originated from seven countries, most of them from the United States (n = 31). Twenty-nine studies examined self-management in diabetes, eight in cardiovascular diseases, and three in a risk of cardiovascular diseases. The included studies consisted of 22 randomized controlled trials and 18 other trials. The methodological quality of the studies ranged from 9 to 25 points, with a total possible MQSQ sum of 28 points (9–12 points, 5 studies; 13–20 points, 23 studies; 21–25 points, 12 studies; see Table 3). Points were typically subtracted due to an absence of randomization or blinding, or due to a lack of reporting about them. No original studies were excluded, since the focus of the review was on qualitative description of LHWs and interventions. Additionally, MQSQ does not set any score limits for the appropriate level of study quality.

The durations of the self-management interventions varied from one day to 24 months. The number of baseline recipients in all the included studies was 10,065 (female 55%) and follow-up 7,970, with a total attrition rate of 21%. The studies varied largely in their reporting. For example, in some papers the background, training, and duties of LHWs as well as intervention details were clearly presented, and in others they were not. Due to the high number of studies included in the current review, the original studies will be cited according to the numbers referred to in Table 3.

Characteristics of LHWs and their training

The individual skills and characteristics often included having the similar health condition or experience of it as the participants had[8,10,12,16,20,21,32,38]. LHWs came from the same community as the recipients did[6,8,26], and some of them also had a professional

background[24,26]. Many of the studies were located in minority communities, therefore LHWs were often bilingual, combining, for example, Spanish and English[11,25,27,30,31].

Training educators were revealed to be health professionals[7,14], specialists[1,28], or university researchers[25,29]. **Training content** consisted of using community resources, navigating health care services, and organizational issues.[5,8,9,12,16,18,20,22,29] (See Figure 2.) Additionally LHWs' training also included themes of supporting effective self-management techniques, such as motivational, self-monitoring and measuring [2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40], alongside clinical protocols [8,11,16,25,34,35], medication [9,20,34] and self-care routines [9,16]. The training **elements** varied from, for example, classroom activities[8,28,38,40] to home visits[9]. The LHWs were also trained in research practices[2,5,8,12,16,25,28,38], protecting human subjects[5,18,25], and cultural awareness[5,18].

The number of LHWs within one intervention varied from 1[14] to 41[16]. LHWs had **multiple roles and duties related to intervention components.** Between the education sessions, LHWs contacted participants to provide support or to answer their questions[1,7,17,25,35,39]. They were also available for recipients' phone calls.[1] In a few interventions LHWs worked as equal members of health care teams[5,11,12,24,27,29,30,33,34,40].

LHWs also collected research data [1,25,31], contributed to intervention evaluations[25], and acted as a team leader for a group of LHWs.[4,26,39] Some studies reported **supervision provided to LHWs** by program coordinators[3,4,5,8,9,20,37], nurse care managers[2,3,28], health care teams of community centers[5,37], and university professionals[37]. In some cases, LHWs were provided with a written manual to ensure consistency of delivery.[37,38,40] They consulted with health professionals on any serious symptoms or for measurements of recipients.[11,12,27,32]

Intervention delivery of LHW-led interventions

Nearly half of the 40 studies reported no **theoretical background** for the intervention or program[3,4,6,9,10,12,13,16,18-20,24,26,27,34-36,39], but some did (Table 4). In eight studies the theoretical background was presented as a combination of two theories[5,8,11,23,25,33,38,40]. The framework of an intervention's content or its components was often based on **national guidelines and recommendations** on diabetes[1,2,5,11,12,14,15,26,27,32,35], hypertension[8,29], or cardiovascular diseases[30,39].

Meetings usually **took place** in community centers and churches, often held at a convenient location to the recipients[1,2,4,22,23,25–27,31]. **The length** of sessions, when reported, ranged from 30 to 90 minutes.[26,27,29,37] **Group sizes** varied from two[24,38] to twenty-five[32] participants. In a few interventions the interaction frequency was based on the needs of peers and recipients.[2,21]

LHWs delivered educational activities for individuals or groups, including making action plans, motivating, problem solving, and self-management guidance with support given either face to face by telephone [2,4,5,7,9,10,15,17,22,24,25,27,28,29,33,34,39,40], or online [32]. Home visits were also conducted [11,17]. Some of the LHWs assessed goals [39], provided confidant information [29], or helped patients to understand their long-term conditions and self-management [2,9,25]. All together, the studies reported thirty-five separate **health behavior change techniques** being applied (Table 5).

Recruitment of potential individuals to participate in interventions was conducted at hospitals, health centers, community centers or churches[6,7,8,12,15,34,35], or via the media, websites or seminars[15,22,32]. To ensure **fidelity of program delivery**, classes were

monitored[16,22] or audio recorded[12], checklists were completed[21] or activity reports were submitted[22]. Interventions acted as **bridges to local health and social services** by encouraging participants to continue with their health care services[3,5,6,14,16,17,18,19,21,22,28,31,37,38,39]. **Attrition prevention** was performed by implementing make-up sessions[31], providing cash incentives, stipends or gift cards[14,19,20,37,39], and making telephone support calls to recipients who did not attend the sessions[18].

PA and NB outcomes in the LHW-led interventions

Statistically significant improvements (minimum of $p < .05$) in all self-management outcomes, including psychological, behavioral, and clinical outcomes, were reported in many studies. Because our review concentrated on behavior, the outcomes of PA and NB as self-management activities, and their links to clinical outcomes, are presented. Ten studies measured both PA and NB, and three studies measured only PA (see Table 6). Measurements of the studies were mostly pre- and posttest, with only two studies having follow-ups[32,37].

Out of ten studies that investigated both PA and NB, six reported both improved PA and NB[7,23,25,29–31], two reported improved NB[21,37], one reported improved PA[17], and one found no improvements[15]. NB- and PA-effective interventions were organized into groups, and four of ~~them~~ these had additional individual activities.[7,23,25,31] Their length varied from two-and-a-half months[25] to 12 months[30]. Four of them provided activities weekly, and five had education lectures. Their number of identified BCTs were eight[29] or nine[7,25,30]. Three of the NB- and PA-effective interventions also improved clinical measurements such as HbA1C[7,23,25], blood pressure[23,25,29], blood lipids[23,29,30], and weight loss[7,23,29], and one[31] found no clinical improvements. (Table 7)

The current review also aimed to identify PA- and NB-effective interventions separately to get more accurate results concerning behavior change in LHW-led self-management interventions. In PA-effective interventions[7,17,23,25,29–32] the number of applied BCTs varied from three to fifteen. In some of the interventions, group meetings were combined with individual face-to-face meetings, at recipients' homes, or via telephone. In PA-ineffective interventions[15,21,26,33,37] the intervention components were mainly similar to effective PA interventions, with two of them providing only individual meetings. The number of BCTs ranged from two to nine. Regarding the high number of applied BCTs, certain remarks appeared in terms of PA as a form of self-management activity. Self-monitoring, enhancing social support, hands-on activities, and self-efficacy support were mainly linked to improvements, whereas goal setting was linked to both improvements and no improvements. Increased PA was often related to positive effects on clinical measurements, but not in all cases.

In NB-effective interventions[7,21,23,25,29-31,37] the number of BCTs was from three to nine, with some variations in techniques, theoretical backgrounds, and durations. In those studies, it was more likely that self-monitoring, goal setting, and motivation were used as BCTs. For example, information providing had been used in four studies where NB improved but also in both studies where no improvement was found. When measured alongside NB, many studies also found positive effects on clinical measurements. Nevertheless, despite the improved NB, blood pressure was more likely to increase than decrease.

Discussion

The current review found that LHW-led self-management interventions have potential in promoting self-management in LTC. The implementation of interventions varied widely.

Only about one third of the studies investigated NB and PA as indicators of behavior change, however, some of those that did had found positive outcomes.

The findings show that LHWs were often themselves trained LTC patients, who were personally interested in acting as LHWs. This study restates the previous descriptions of LHWs (Hunt et al., 2011; South, Kinsella & Meah, 2012; South et al., 2013), who are considered to be trained peer workers, as having similar cultural, ethnic or health backgrounds to their clients. LHWs' roles were identified as educators, supporters, opinion leaders, organizers, and acting as bridges between communities, professionals, and clients. Interventions typically encompassed empowerment, social support, and tailoring-oriented principles, and they varied widely in length, frequency, and components. For example, group sessions, education lectures, and individual appointments were common formats, whereas self-monitoring, goal setting, information providing, action plans, and social support were frequently applied BCTs. Similar formats and BCTs were often applied in effective as well as in non-effective interventions.

The implementation of and reporting on both LHW training and LHW-led interventions diverged, as has been shown in previous studies (Hunt et al., 2011; Shah et al., 2013). A number of interventions lacked a theoretical background, or at least did not report one (Hunt et al., 2011; Dale et al., 2012), which is a common issue in evidence-based health promotion. Implementation quality was assured in many interventions by providing continuous supervision during the intervention process (Hunt et al., 2011). That can be considered as a way to empower LHWs to be self-management tutors, and also assist them in cooperating with each other. As a non-professional workforce, they may benefit from organizational support for their work.

Interventions often followed national recommendations or guidelines for particular LTCs, as well the program for chronic disease self-management (Lorig et al., 2013). However, the current review highlights self-management as a person's own activities and emotions for taking care of a LTC by, for example, setting and modifying goals, solving problems, relying on peer support, and action planning (also Richardson et al., 2014). It seems that part of the interventions emphasized lecturing and giving advice, while many interventions consisted of behavioral and emotional elements that supported self-management (also Kawi, 2012; Lorig, Ritter, Ory & Whitelaw, 2013; Kaptein, et al., 2014). Effective self-management support should correspond to recipients' unique needs as well as assist individuals in strengthening their motivation and skills in coping in daily life with an LTC (Newbould, Taylor, & Bury, 2006). However, participants who lack knowledge and others with low self-efficacy may fail to benefit from similar activities and support in improving their self-management. These demands have been responded to in many interventions by tailoring intervention activities according to individual participants' requirements.

This review had similar findings to previous work, in that LHW-led self-management interventions can be effective in HbA1c (Hunt et al., 2011; Dale et al 2012; Little et al., 2014), and in a few interventions in PA, NB, blood pressure, and blood lipids (Hunt et al., 2011; Dale et al., 2012). Even though the same components and BCTs led to both significant and non-significant outcomes, some preliminary but not robust links were observed. Group meetings and enhancing social support seemed to be particularly effective in improving PA. This reflects earlier findings (Greaney et al., 2017) and also highlights the need for social activities and for sharing motivation and feelings with LHWs and other recipients when improving one's PA. Furthermore, self-monitoring and hands-on activities and exercises as self-management actions were more likely linked to both improved PA and NB. Regarding the findings of generally applied BCTs in PA interventions (Duff et al., 2017), goal setting

did not appear as an effective BCT at this time. However, in terms of behavior change interventions, only about one third of the studies measured NB and/or PA as an outcome of behavior change. In considerations of behavior changes among long-term patients, measuring their health behavior may provide beneficial knowledge on how patients manage with self-management in the context of their daily lives. Both research and clinical practice would benefit from this information.

Thus, a particular intervention component does not consistently lead to improvements. Firstly, identifying and understanding (Johnston et al., 2017) formats and BCTs and, second, applying them in self-management interventions are demanding processes, especially deciding how to maintain techniques based on recipients' unique needs, such as motivation or making action plans. When the training periods of LHWs last from days to months, it may have been challenging to learn the further ethos of the BCTs that were applied. In a portion of the interventions it remained unclear how the LHWs were trained in BCTs. Furthermore, based on the results of this study, it is possible that other intervention components, such as intensity (Palmas et al., 2015), duration, and overall personal interaction between LHWs and participants may play a role in effective interventions.

Nevertheless, as this review suggests, LHWs may have particular potential in self-management interventions among cultural and lingual minorities due to their reciprocal ability to share culture and experiences. They may have the potential to increase vulnerable individuals' involvement in services but also to promote self-management and health behavior change.

Limitations and strengths

The collected data enabled specific examinations of LHW-led self-management interventions, yet the current study has its limitations. The study protocols differed, combining RCT and trials with a variety of study participants. Due to the high variability and high numbers of different BCTs and self-management outcomes reported within the data, the evidence for making links between techniques and outcomes is limited. However, only the most prominent themes are presented in this paper. The heterogeneity across interventions and outcomes may also lead to limitations in identifying the intervention components (Abraham et al., 2015; Johnston et al 2017) and determining the results of this review, which itself contains reviews by Carr et al. (2011) and Little et al. (2014). The recipients of the original studies often represented cultural or linguistic minorities or low-income groups, so the results may not be transferable to other groups. In addition, there may be a risk of language bias because the included studies had to be reported only in English (CRD, 2009). Nevertheless, to our knowledge, the major studies regarding the topic have been conducted in an international context and reported in English.

This study has three primary strengths. First, it sets out a systematic synthesis of the characteristics and training of LHWs, the implementation and components of LHW-led interventions, and BCTs. The synthesis could serve as a framework for future research and clinical practice considering LHW-led self-management interventions. Second, it contains a number of original studies that provide robust data on LHW-led self-management interventions among people with diabetes and cardiovascular disease. Third, it presents preliminary links between intervention components and outcomes in the field of LHW-led self-management interventions. To our knowledge, there is currently only scant evidence of such a link.

Implications for Policy and Practice

LHW interventions, as a mode of health services for multiple groups of people, have the potential to improve self-management for those with diabetes, cardiovascular diseases and chronic conditions as well as assist in prevention. LHW-led services in self-management support may reach people who are vulnerable or underserved. However, to improve self-management in LTC, systematic training in adopting and applying formats and BCTs should be provided to LHW candidates. In the future, an evidence-based standard for LHW training and interventions may be formulated for the field of LHW self-management interventions and their investigation. Such a standard, however, requires further research on its implementation.

Another suggestion for further research on self-management outcomes of LHW interventions would be to examine whether interaction frequency, meeting minutes, or group size have effects on self-management and, if so, what are the mechanisms that make them effective. A further line of study could determine how different combinations of intervention formats and BCTs interact.

Additionally, promoting recipients' self-regulation strategies or improving their psychological flexibility as stages of health behavior change may offer new ways to achieve goals in LHW interventions. In summary, the results of this review suggest that LHW-led self-management interventions for diabetes and cardiovascular diseases have been implemented in multiple ways, and these interventions have seemed to improve, at least partially, behavioral and clinical self-management outcomes.

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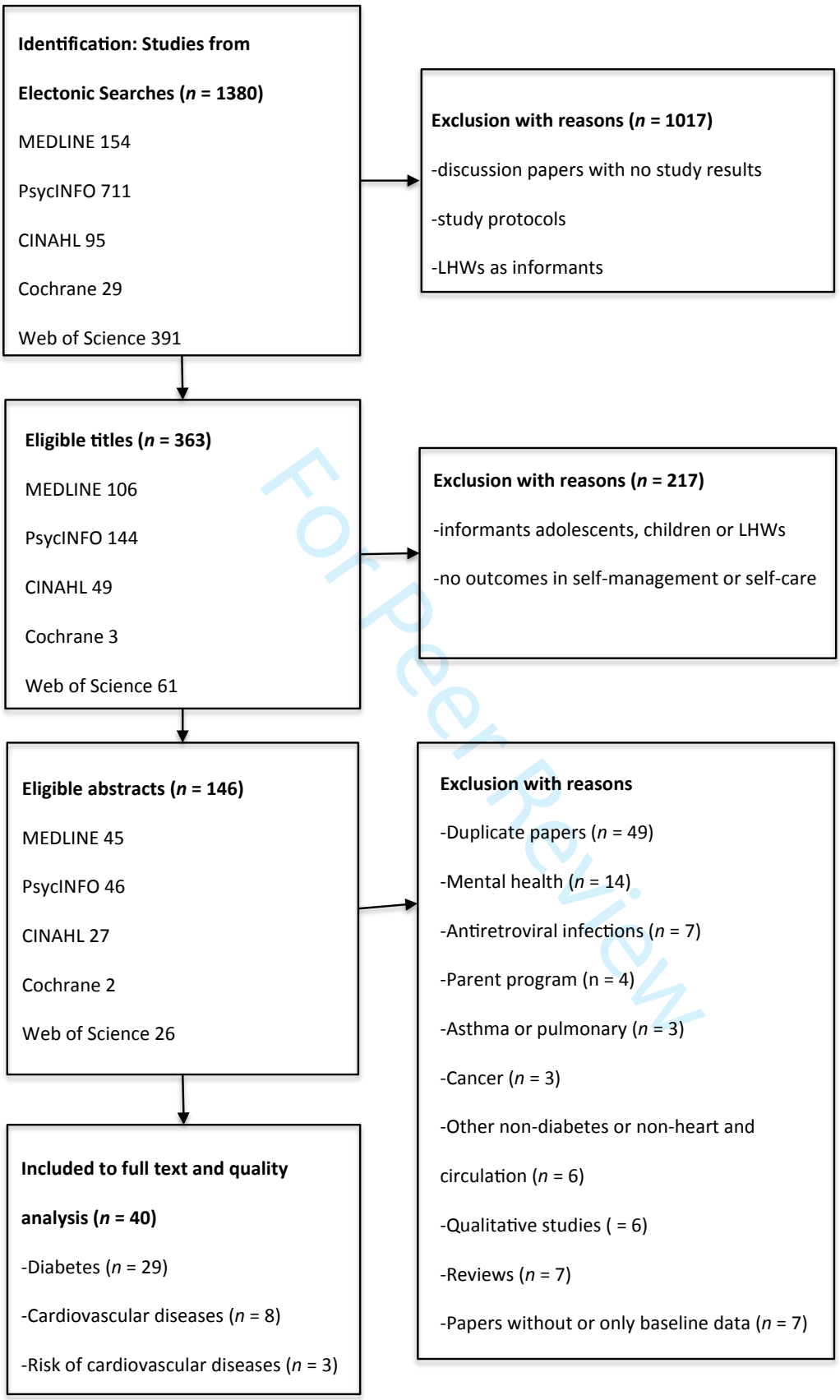

Figure 1. Flowchart of the searches.

Table 1. Example of the content analysis phase concerning LHW characteristics

Examples of the original expressions	Condensed expression	Subcategory	Main category
[The facilitators were six lay people with experience of heart disease, either personally -- or as carers of people with heart disease. 3.10]	The facilitators were six lay people with experience of heart disease self-management	Background and experience	Characteristics of LHWs
[The CHWs had an average of 6 years' experience leading DSME at CHASS. 18.22]	The CHWs had an average of six years' experience in leading diabetes self-management programs		
[--co-delivered by -- a patient (lay) tutor who had experience in these services 40.11.1]	Patient lay tutor had experience of services related to self-management support		
[-- an organization devoted to the education of people with diabetes and health care team members, on the basis of their excellent diabetes control, self-motivation, communication and support skills and interest. 4.21]	On the basis of their excellent diabetes control, self-motivation, communication and support skills and interest.	Eligibility criteria	
[simply interest of being a diabetes educator 24.9]	Simply one's own interest of being a diabetes educator		

[someone with diabetes or with a family member or friend with diabetes 24.8]	Having diabetes her/himself or a family member who has		
[16 hours training by the project manager or principal investor. 1.14]	Training provided by the project manager or principal investor	Training educators	LHWs' training
[The trainings were delivered by an interdisciplinary team of academics and practitioners with expertise in clinical medicine, health inequities, Latino health, diabetes self-management, diabetes medications, nutrition, exercise, cross-cultural counseling, and mental health. 11.27]	The culturally sensitive training delivered by an interdisciplinary team of academics and practitioners		
[CHWs trained by research staff from the University of Illinois at Chicago (UIC) 25.2.1]	CHWs trained by research staff from the University		
[to teaching blood pressure and glucose readings 1.18]	Training prepared CHWs in teaching blood pressure and glucose readings	Training purposes	
[building and reinforcing the participants' knowledge on diabetes, 23.22]	Building and reinforcing the participants' knowledge on diabetes		
[We trained community volunteers to be "Health	To train community volunteers to be health coaches		

Coaches" for our project -- 29.34]

Table 2. Examples of self-management outcomes transferred to self-management items

Item of self-management	**An example of original self-management measurement**
Physical activity (PA)	Summary of Diabetes Self-Care Activities measure[7]*
	Moderate levels of physical activity 30 min per day at least 5 days per week[17]
	Physical Activity Scale for Elderly[21]
	Survey of Diabetes Self-Care Activities: Exercise[23]
	Minutes of daily physical activity[25]
	Questionnaire on physical activity[37]

Nutrition behavior (NB)	Number of days to follow a diet[7]
	Amount of daily servings of vegetable and fruits[17]
	Survey of Diabetes Self-Care Activities: Nutrition[23]
	Following a healthy eating plan, eating fruits/vegetables[25,30]
	Self-reported eating behavior[29]
	Questionnaire on nutrition[31,37]
Blood lipids	HDL[23,30,35] LDL[17,30]
	Total cholesterol[23,30] Triglycerides[30]
Blood pressure	Systolic[23,25,29]
	Diastolic[23]

*References in Table 3.

Table 3. Studies included in the analysis

Number	Original Paper	Purpose of LHW intervention	Field	Method	Main outcome, analysis	Setting	Follow-up, *N* =	Format (briefly)	Months of duration + follow-up	Quality assessment score
1	Daniels, E., Powe, B., Metoyer, T., McCray, G., Baltrus, P., & Rust, G. (2012). Increasing knowledge of cardiovascular risk factors among African Americans by use of community health workers: The ABCD community intervention pilot project. *Journal of the National Medical Association*, *104*(3-4), 179–185. USA	To increase knowledge of cardiovascular risk among African-Americans	CVD	RCT	Knowledge of CVD, health literacy, Depression, HBA1C, BP, cholesterol, BMI, waist circumference *t* tests	Church	25	Group meeting Telephone counselling	1.5	17
2	DePue, J., Dunsiger, S., Seiden A., Blume, J., Rosen, R., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S. (2013). Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial.*Diabetes Care, 36*(7), 1947–1953.	To support diabetes self-management among American Samoans	T2DM	RCT	HBA1C, BP, BMI, waist circumference, dietary intake Wilcoxon, *t* test, mixed effects	CHC	243	Group meetings Individual meetings	12	22

	American Samoa, USA				longitudinal regression model					
3	Furze, G., Cox, H., Morton, V., Chuang, L-H., Lewin, R.J.P., Nelson, P., Carty, R., Norris, H., Patel, N., & Elton, P. (2012). Randomized controlled trial of a lay-facilitated angina management programme. *Journal of Advanced Nursing, 68*(10), 2267–2279. England	To assess the effectiveness of a angina management program	CVD (Angina manage-ment)	RCT	Angina frequency (1-week angina diary) Negative binomial, linear and logistic regression	Home-based	124	Individual interview Home visits Telephone calls	3	20
4	Gagliardino, J.J., Arrechea, V., Assad, D., Gagliardino, G.G., González, L., Lucero, S., Rizzuti, L., Zufriategui, Z., & Clark, C Jr. (2013). Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals.*Diabetes/Metabolism Research & Reviews, 29*(2), 152–160. Argentina	To compare standard care and the care and ongoing support of trained peers for people with T2DM	CVD (Hyper-tension)	RCT	HBA1C, BMI, BP, cholesterol, attitudes regarding diabetes and their care Chi-square test, *t* test	Health education center	198	Peer support group Face-to-face visits Telephone communication	1.5	15

5	Hargraves, J.L., Ferguson, W.J., Lemay, C.A., & Pernice, J. (2012). Community health workers assisting patients with diabetes in self-management. *Journal of Ambulatory Care Management, 35*(1), 15–26. Massachusetts, USA	To integrate community health workers into work with diabetes type 2 patients and support diabetes self-management	T2DM	RCT	HBA1C, cholesterol, BP, self-management Hierarchical regression, logistic models, correlations	CHC	1,415	LHW in health care teams	13	9
6	Kronish, I.M., Goldfinger, J.Z., Negron, R., Fei, K.Z., Tuhrim, S., Arniella, G., & Horowitz, C.R. (2014). Effect of peer education on stroke prevention: The Prevent Recurrence of All Inner-City Strokes Through Education (PRAISE) randomized controlled trial. *Stroke*, *45*(11), 3330–3336. New York City, USA	To determine the effect of peer education on secondary stroke prevention	CVD (Stroke)	RCT	BP, cholesterol, use of antithrombotic medications, control of the stroke risk factors *t* test for continuous variables, χ^2 analysis for categorical variables, mixed models	Primary health care	510	Group meetings	1.5 + 6	20
7	Lynch, E.B., Liebman, R., Ventrelle, J., Avery, E., & Richardson, D. (2014). A self-	To determine the effectiveness of	T2DM, CVD	RCT	Medical history, clinical variables,	Community setting	55	Group sessions	6	19

	management intervention for African Americans with comorbid diabetes and hypertension: A pilot randomized controlled trial. *Preventing Chronic Disease*, *11*, 130349. Chicago, USA	comorbid diabetes and hypertension self-management intervention for African Americans	(hypertension)		BMI, medications, dietary intake, PA, health literacy, nutrition knowledge and quality of life *t* tests, χ^2 tests, Fisher's exact test, continuous variables, Wilcoxon rank-sum test			Telephone calls		
8	Martin, M.Y., Kim, Y.I., Kratt, P., Litaker, M.S., Kohler, C.L., Schoenberger, Y.M., Clarke, S.J., Prayor-Patterson, H., Tseng, T.S., Pisu, M., & Williams, O.D. (2011). Medication adherence among rural, low-income hypertensive adults: a randomized trial of a multimedia community-based intervention. *American Journal of Health Promotion, 25*(6), 372–378. Alabama, USA	To examine the effectiveness of community-based multimedia intervention in medication adherence among hypertensive patients	CVD (hypertension)	RCT	Pill count Means, standard deviations, frequencies. χ^2 analysis, general linear model	Online, CHC	338	Online program Home visits Telephone calls	6 + 6	16

9	McDermott, R.A., Schmidt, B., Preece, C., Owens, V., Taylor, S., Li, M., & Esterman, A. (2015). Community health workers improve diabetes care in remote Australian Indigenous communities: results of a pragmatic cluster randomized controlled trial. *BMC Health Services Research*, *15*, 68. Australia (north)	To test the effectiveness of a community-based approach to intervention for indigenous adults with poorly controlled T2DM in Australian indigenous communities	T2DM	RCT	HBA1C *t* tests, Wilcoxon rank sum tests, chi-square test, generalized estimating equations regression models	Primary health care	191	LHW in health care team	18	20
10	Moskowitz, D., Thom, D.H., Hessler, D., Ghorob, A., & Bodenheimer, T. (2013). Peer coaching to improve diabetes self-management: Which patients benefit most? *Journal of General Internal Medicine*, *28*(7), 938–942. San Francisco, USA	To examine the effect of peer health coaching on HbA1C modified by diabetes control characteristics	T2DM	RCT	HbA1C *t* tests, Fischer's exact test	Public health care	299	NR	6	18
11	Perez-Escamilla, R., Damio, G., Chhabra, J., Fernandez, M.L., Segura-Perez, S., Vega-Lopez, S., Kollannor-Samuel, G., Calle, M., Shebl, F.M., & D'Agostino, D. (2015). Impact of a Community Health Workers-Led Structured Program on Blood	To evaluate home-based culturally appropriate CHW-integrated T2DM counselling among Latino adults	T2DM	RCT	HbA1c, BG and lipid profile χ^2 test for categorical variables and independent samples ANOVA	Primary health care	148	Home visits	12 + 6	22

	Glucose Control Among Latinos With Type 2 Diabetes: The DIALBEST Trial. *Diabetes Care*, *38*(2), 197–205. Connecticut, USA				for continuous variables, a linear mixed effects					
12	Philis-Tsimikas, A., Fortmann, A., Lleva-Ocana, L., Walker, C., & Gallo, L.C. (2011). Peer-Led Diabetes Education Programs in High-Risk Mexican Americans Improve Glycemic Control Compared With Standard Approaches A Project Dulce Promotora Randomized Trial. *Diabetes Care*, *34*(9), 1926–1931. San Diego, USA	To evaluate the effect of a culturally sensitive diabetes self-management program among Mexican-American with T2DM	T2DM	RCT	HbA1C Multilevel models, within-group analysis	CHC	156	Learning class Support group Telephone calls	10 + 4	15
13	Prezio, E.A., Pagan, J,A., Shuval, K., & Culica, D. (2014). The Community Diabetes Education (CoDE) program: cost-effectiveness and health outcomes. *American Journal of Preventive Medicine*, *47*(6), 771–779. USA	To examine the long term cost effectiveness and improvements in diabetes-related complications	T2DM	RCT	HBA1c Archimedes model	NR	10 000’	NR	NR	15
14	Prezio, E.A., Cheng, D., Balasubramanian, B.A., Shuval, K., Kendzor, D.E., & Culica, D. (2013). Community Diabetes Education	To determine the impact of a culturally tailored diabetes education	T2DM	RCT	HbA1C *t* test to continuous	CHC	156	LHW appointments along with usual	12	23

	(CoDE) for uninsured Mexican Americans: a randomized controlled trial of a culturally tailored diabetes education and management program led by a community health worker. *Diabetes Research & Clinical Practice*, *100*(1), 19–28. Texas, USA	program for uninsured Mexican-American with DM			variables and Pearson χ^2 for categorical variables, linear mixed-models			care		
15	Rothschild, S.K., Martin, M.A., Swider, S.M., Tumialan Lynas, C.M., Janssen, I., Avery, E.F., & Powell, L.H. (2014). Mexican American trial of community health workers: a randomized controlled trial of a community health worker intervention for Mexican Americans with type 2 diabetes mellitus. *American Journal of Public Health*, *104*(8), 1540–1548. Chicago, USA	To assess whether community health workers could improve glycemic control among Mexican-Americans with diabetes	T2DM	RCT	DM empowerment, DM self-care Activities (also PA, nutrition), depression, stress scale, anxiety *t* test, Wilcoxon rank sum test, mixed effect linear model analysis.	Community setting	121	Telephone calls Home visits	24	25
16	Safford, M.M., Andreae, S., Cherrington, A.L., Martin, M.Y., Halanych, J., Lewis, M., Patel, A., Johnson, E., Clark, D.,	To test the effectiveness of peer coaches plus brief diabetes education	T2DM	RCT	HbA1c, systolic BP, LDL-C, BMI, and	Community setting	270	Meetings Telephone calls	10 + 5	23

	Gamboa, C., & Richman, J.S. (2015). Peer Coaches to Improve Diabetes Outcomes in Rural Alabama: A Cluster Randomized Trial. *Annals of Family Medicine*, *13*(S1), S18–S26. Alabama, USA	compares with brief education alone in Rural Alabama			quality of life Frequencies and *p* values					
17	Spencer, M.S., Rosland, A.M., Kieffer, E.C., Sinco, B.R., Valerio, M., Palmisano, G., Anderson, M., Guzman, J.R., & Heisler, M. (2011). Effectiveness of a community health worker intervention among African American and Latino adults with type 2 diabetes: a randomized controlled trial. *American Journal of Public Health, 101*(12), 2253–2260. Detroit, USA	To test a culturally tailored CHW intervention for diabetes self-management improved diabetes clinical measures, self-management and distress among African American and Latino adults	T2DM	RCT	HbA1C, PA, nutrition Student *t* test, Pearson $\chi 2$ test	Community health center	136	Home visits Group classes Telephone calls	6	21
18	Tang, T.S., Funnell, M., Sinco, B., Piatt, G., Palmisano, G., Spencer, M.S., Kieffer, E.C. ,& Heisler, M. (2014). Comparative effectiveness of peer leaders and community health workers in diabetes self-	To compare a peer leader (PL) versus a community health worker (CHW) telephone intervention	T2DM	RCT	HbA1C Linear mixed methods, Student's *t* test, log-rank test, Fisher exact test,	Community setting	69	Group Classes Home visits Primary care provider visits	18	23

	management support: Results of a randomized controlled trial. *Diabetes Care*, 37 (6), 1525–1534. Detroit, USA	in diabetes self-management education			Pearson χ^2 test			Telephone calls		
19	Tang, T.S., Funnell, M.M., Sinco, B., Spencer, M.S., & Heisler, M. (2015). Peer-Led, Empowerment-Based Approach to Self-Management Efforts in Diabetes (PLEASED): A Randomized Controlled Trial in an African American Community. *Annals of Family Medicine*, *13*(S1), S27–S35. Michigan, USA	To investigate whether a peer support model could sustain improvements achieved in a short-term diabetes self-management education program for African American adults with type 2 diabetes	T2DM	RCT	HbA1C Linear mixed model, Spearman correlation, Student's *t* test, log rank test, Fisher's exact test, Pearson's $\chi 2$	Community setting	64	Group sessions Face to face meetings Telephone calls	15	25
20	Thom, D., Ghorob, A., Hessler, D., DeVore, D., Chen, E., & Bodenheimer, T.A. (2013). Impact of peer health coaching on glycemic control in low-income patients with diabetes: A randomized controlled trial. *Annals of Family Medicine*, *11*(2), 137–144. San Fransisco, USA	To test the impact of individual peer coaching on glucose control on patients with poorly controlled diabetes	T2DM	RCT	HbA1C Linear mixed model, logistic regression	Public clinics	275	In person interactions Telephone calls	6	20

21	van der Wulp, I., de Leeuw, J.R.J., Gorter, K.J., & Rutten, G.E.H.M. (2012). Effectiveness of peer-led self-management coaching for patients recently diagnosed with Type 2 diabetes mellitus in primary care: a randomized controlled trial. *Diabetic Medicine*, *29*(10), e390–e397. Netherlands	To study the effectiveness of a self-management coaching intervention in recently diagnosed patients with Type 2 diabetes	T2DM	RCT	Self-efficacy, coping, physical activity, dietary habits, psychological well-being, depressive symptoms and diabetes related distress Analysis of variance	General practices	119	Home visits Telephone calls Emails	18	22
22	Whittle, J., Schapira, M.M., Fletcher, K.E., Hayes, A., Morzinski, J., Laud, P., Eastwood, D., Ertl, K., Patterson, L., & Mosack, K.E. (2014). A randomized trial of peer-delivered self-management support for hypertension. *American Journal of Hypertension*, *27*(11), 1416–1423. Milwaukee, USA	To compare changes in BP control among veterans participating in a peer-delivered vs. Professionally delivered health education intervention	CVD (Hyper-tension)	RCT	Systolic BP Mixed model, generalized linear model	Veterans' service organizations	379	Group sessions	12	24
23	Assah, F.K., Atanga, E.N., Enoru, S., Sobngwi, E., & Mbanya, J.C. (2015).	To examine the effectiveness of a	T2DM	Trial	HBA1C, BP, blood lipids, BMI, waist	Communit	192	Group meetings	6	17

	Community-based peer support significantly improves metabolic control in people with Type 2 diabetes in Yaounde, Cameroon. *Diabetic Medicine*, *32*(7), 886–889. Cameroon	structured peer support diabetes intervention in Cameroon		circumference, diabetes self-care (also PA and nutrition) Continuous variables and differences, Student *t* test	y setting		Personal encounters Telephone calls		
24	Carey, M.E., Mandalia, P.K., Daly, H., Gray, L.J., Hale, R., Stacey, L.M., Taub, N., Skinner, T.C., Stone, M., Heller, S., Khunti, K., & Davies, M.J. (2014). Increasing capacity to deliver diabetes self-management education: Results of the DESMOND lay educator non-randomized controlled equivalence trial. *Diabetic Medicine*, *31*(11), 1431–1438. England and Scotland	To develop and test a format of delivery of diabetes self-management education by paired professional and lay educators	T2DM	trial	Diabetes coherence, diabetes perception Intra-class-correlations, continuous and categorical variables, *t* test, χ^2, Wilcoxon test	Primary health care	242	Group meeting	1 day	20

25	Castillo, A., Giachello, A., Bates, R., Concha. J., Ramirez, V., Sanchez, C., Pinsker, E., & Arrom, J. (2010). Community-based diabetes education for Latinos: The Diabetes Empowerment Education Program. *Diabetes Educator*, *36*(4), 586–594. California, USA	To test the feasibility and effectiveness of a linguistic and culturally appropriate diabetes education program among Latinos	T2DM	trial	HbA1C, PA, nutrition Frequency tables and cross-tabulations, *t* tests, χ^2 tests	Community setting	47	Group meeting Group and individual activities	2.5	15
26	Cene, C.W., Haymore, L.B., Ellis, D., Whitaker, S., Henderson, S., Lin, F.C. & Corbie-Smith, G. (2013). Implementation of the power to prevent diabetes prevention educational curriculum into rural African American communities: A feasibility study. *The Diabetes Educator*, *39*(6), 776–785. North Carolina, USA	To describe the feasibility of using a community-based approach to implement a diabetes prevention education curriculum in rural African-American settings	T2DM	Trial	BG, BP, BMI, PA Mc Nemar test, *t* test	Community setting	30	Small group sessions	7.5	11
27	Collinsworth, A.W, Vulimiri, M., Schmidt, K. L., & Snead, C.A. (2013). Effectiveness of a community health worker–led diabetes self-management education program and implications for CHW involvement in care	To evaluate the effectiveness of a diabetes self-management education program and to	T2DM	Trial	HBA1C, BMI, Blood pressure *t* test	Community clinic	497	Group meetings Clinical assessments	12	12

	coordination strategies. *The Diabetes Educator*, *39*(6), 792–799. Dallas, USA	understand how CHWs and primary care providers work together								
28	DePue, J.D., Rosen, R., Seiden, A., Bereolos, N., Chima, M., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S.T. (2013). Implementation of a culturally tailored diabetes intervention with community health workers in American Samoa. *The Diabetes Educator*, *39*(6), 761–771. American Samoa, USA	To investigate a primary care–based, nurse–community health worker (CHW) team intervention to support type 2 diabetes self-management in American Samoa	T2DM	Trial	HBA1C, BP, smoking status, alcohol use, depression score, treatment dose ANOVA, Tukey's post hoc test, nonparametric comparison of medians, χ^2-tests	Primary care	104	Group visits Individual visits	12	16
29	Dye, C., Williams, J., & Hoffman Evatt, J. (2015). Improving hypertension self-management with community health coaches. *Health Promotion Practice*, *16*(2), 271–281. Appalachians, USA	To improve hypertension self-management among rural residents older than 60 years through education and support	CVD (Hyper-tension)	Trial	Hypertension knowledge and self-management, BP, weight, waist circumference, blood lipids and	Community setting	146	Group classes Education program	4	20

					BG, PA, nutrition Student *t* test, McNemar's test, Bonferroni correction					
30	Fernandes, R., Braun, K., Spinner, J., Sturdevant, C., Ancheta, S., Yoshimura, S., Compton, M., Wang, J-H., & Lee, C. (2012). Healthy heart, healthy family: A NHLBI/HRSA collaborative employing community health workers to improve heart health. *Journal of Health Care for the Poor and Underserved*, *23*(3), 988–999. Hawaii, USA	To evaluate the impact of the heart health curriculum on low-income Filipinos with CVD risk factors in Hawaii	CVD	Trial	Disease and medication histories, BMI, waist circumference, BP, BG, lipid profile, HBA1C, PA, nutrition *t* tests, chi-squared	Community setting	92	Group sessions	12	16
31	Islam, N., Wyatt, L., Patel, S., Shapiro, E., Darius Tandon, S., Runi Mukherji, B., Tanner, M., Rey, M.J., & Trinh-Shevrin, C. (2013). Evaluation of a community health	To explore the impact and feasibility of a pilot intervention to improve diabetes management	T2DM	Trial	HBA1C, weight, nutritional and physical activity behaviors, access to	Clinical and community setting	26	Group sessions Individual visits	9	20

	worker pilot intervention to improve diabetes management in Bangladeshi immigrants with type 2 diabetes in New York City. *The Diabetes Educator*, *39*(4), 478–493. New York, USA	among Bangladeshi-American individuals with type 2 diabetes living in New York City			health care, diabetes knowledge, self-management, self-efficacy, mental health Fisher's exact test, *t* test, frequencies, means, standard deviations					
32	Lorig, K., Ritter, P.L., Plant, K., Laurent, D.D., Kelly, P., & Rowe, S. (2013). The South Australia Health Chronic Disease Self-management Internet Trial. *Health Education & Behavior*, *40*(1), 67–77. South Australia	To implement and investigate the effectiveness of a chronic condition self-management internet trial in South Australia	CC	Trial	Pain/physical discomfort, shortness of breath, tiredness, impact of disease, health distress, self-rated disability, number of illness days, PA Paired *t* tests	Online-based, community setting	194	Interactive web program	1.5 + 12	21

33	Micikas, M., Foster, J., Weis, A., Lopez-Salm, A., Lungelow, D., Mendez, P., & Micikas, A. (2015). A Community Health Worker Intervention for Diabetes Self-management Among the Tz'utujil Maya of Guatemala. *Health Promotion Practice*, *16*(4), 601–608. Guatemala	To investigate the effectiveness of a structured, community-led diabetes self-management intervention among the Tz'utujil Maya of Guatemala	T2DM	Trial	Health beliefs, practices, HbA1c, BMI, PA *t* tests	Community setting	52	Individual visits at clinics and home Group sessions	4	14
34	Otero-Sabogal, R., Arretz, D., Siebold, S., Hallen, E., Lee, R., Ketchel, A., Li, J., & Newman, J. (2010). Physician-community health worker partnering to support diabetes self-management in primary care. *Quality in Primary Care*, *18*(6), 363–372. San Francisco, USA	To improve self-management among patients with type 2 diabetes	T2DM	Trial	HbA1c, LDL, BP and total cholesterol, Patient Activation Measure Frequencies, cross tabulations, *t* test comparisons	Primary care	114	Participant visits.	24	9
35	Ryabov, I. (2014). Cost-effectiveness of Community health workers in controlling diabetes epidemic on the US-Mexico border. *Public Health*, *128*(7), 636–642.	To evaluate clinical outcomes and long-term cost-effectiveness of T2DM intervention among Mexican-	T2DM	Trial	HbA1c, total cholesterol, HDL, triglycerides, BP, BMI	Community setting	30	Individual visits Telephone contacts	24	13

	Texas, USA	Americans								
36	Ryabov, I. (2011). The impact of community health workers on behavioral outcomes and glycemic control of diabetes patients on the U.S.-Mexico border. *International Quarterly of Community Health Education, 31*(4), 387–399. Texas, USA	To determine the impact of CHW on the self-management practices of people in with diabetes on the US–Mexico border	T2DM	Trial	DM knowledge	NR	30	NR	24	12
37	Saxe-Custack, A., & Weatherspoon, L. (2013). A patient-centered approach using community-based paraprofessionals to improve self-management of Type 2 Diabetes *American Journal of Health Education*, *44*(4), 213–220. Michigan, USA	To examine if a lifestyle management program can initiate positive impacts on self-management and behavior change among participants with type 2 diabetes	T2DM	Trial	BP, BMI, HbA1c, demographic information, lifestyle behaviors (also PA and nutrition), behavior change by stages of change, appraisal of diabetes Paired *t* tests	Community setting	122	Group sessions Individual meetings Home visits	2.5+6	16
38	Tsoh, J., Burke, N., Gildengorin, G., Wong,	To evaluate a smoking	CC	Trial	7-day and 30-day	Communit	192	Small group	2+3	21

	C Le, K., Nguyen, A., Chan, J.L., Sun, A., McPhee, S.J. & Nguyen, T.T. (2015). A Social network family-focused intervention to promote smoking cessation in Chinese and Vietnamese American male smokers: A feasibility study. *Nicotine & Tobacco Research, 17*(8), 1029–1038. USA	cessation program: intention to quit, use of cessation recourses and smoking abstinence	(smoking cessation)		smoking abstinence, assessed by smokers and family members Descriptive statistics, significance, linear model adjustment	y setting		sessions Telephone calls		
39	Tully, M., Kos, A., Eastwood, D., Kusch, J., & Kotchen, T. (2015). Implementation of an adjunct strategy to reduce blood pressure in blacks with uncontrolled hypertension: a Pilot Project. *Ethnicity & Disease*, *25*(2), 168–174. Wisconsin, USA	To describe the development, implementation, and evaluation of a BP program	CVD (blood pressure)	Trial	BP *t* tests and χ^2tests.	Health center	83	Group sessions	6	16
40	Turner, A., Anderson, J.K., Wallace, L.M. & Bourne, C. (2015). An evaluation of a self-management program for patients with long-term conditions. *Patient Education and Counseling*, *98*(2), 213–219. UK	To investigate a self-management program among patients with long-term conditions	CC	Trial	Demographic data, Patient Activation, EuroQol, Hospital Anxiety and Depression, Health Education Impact	Communit y setting	486	Group meetings	2	19

		Questionnaire Paired *t* tests, General linear model, and analysis of covariance, McNemar's test

NR = not reported

CVD = cardiovascular disease

CC = chronic conditions or its prevention

CHC = community health center

‘=estimated

BMI = body mass index

BP = blood pressure

BG = blood glucose

Characteristics and training of LHWs			**Theories and guidelines behind the intervention**
Experience with long-term conditions Eligibility based on personal interest or maintained self-management Length of training from one day to 240 h, approx. 30 to 60 h Elements of training: classroom training, hands-on activities, home visits, clinical measurements Training contents: LTCs, motivation, self-monitoring, self-management, medication	**Self-management intervention components and delivery by LHWs**		National guidelines for DM, hypertension and cardiovascular diseases Transtheoretical model of change Social cognitive theory Chronic care model Self-efficacy theory
	Participants recruited by LHWs or health professionals	Interaction frequency from once a week to every second month, often besides usual health care	
	Attrition prevention by providing, e.g., make-up sessions, telephone support calls, gift cards.	<u>Principles of implementation:</u> individual-empowering, culture and language sensitiveness, peer education, family-centering, social networking	
	<u>Elements:</u> PA, nutrition, medication, clinical measurements, and other education classes; online programs	<u>BCTs:</u> Self-monitoring, goal setting, information providing, action plans, enhancing social support	
	<u>Formats:</u> Individual or group meetings delivered by a LHW or a group of LHWs; LHW as a	provided face to face, via telephone, online, at clinics or community centers or home visits.	

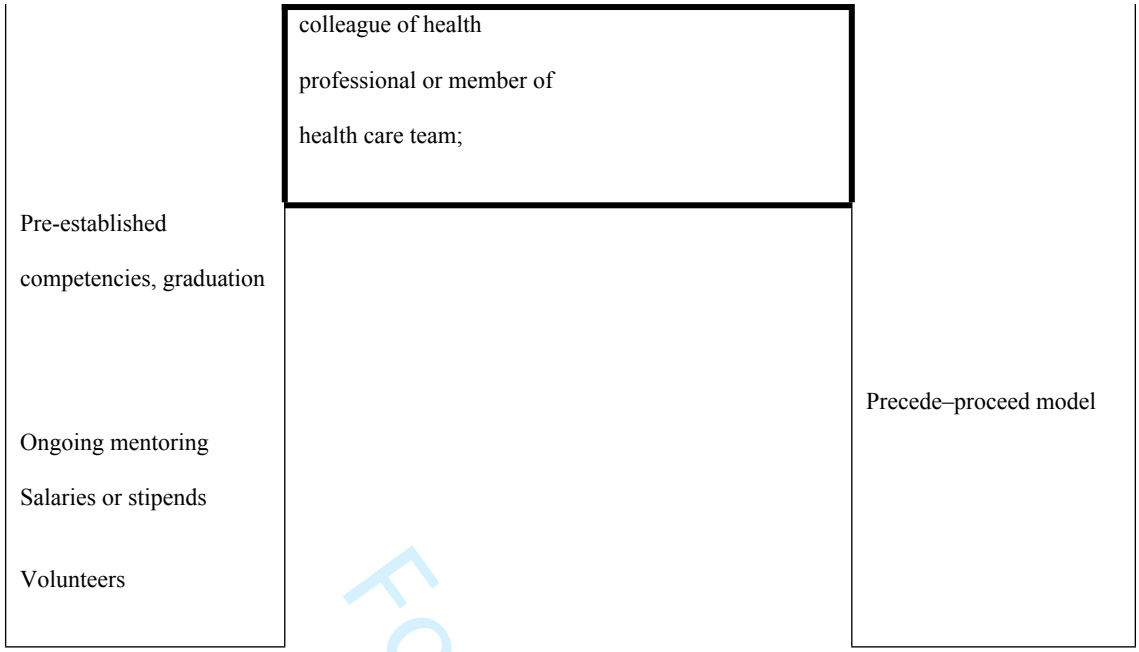

Figure 2. Synthesis of LHW-led self-management interventions for diabetes, cardiovascular diseases and prevention.

Table 4. Reported theories and principles.

Theories and models applied and reported	***n***
Transtheoretical model of change[7,8,11,23,29,30,33,37,38]	9
Social cognitive theory[1,8,14,21,38]	5
Chronic care model[22,40]	2
Self-efficacy theory[31,32]	2

Precede–proceed model[2,28]	2
Socioecological model[5,17]	2
Health belief model[33]	1
Self-management theory[15]	1

Principles and methods applied and reported	***n***
Individual-empowerment[17–19,23,25,33,34,38–40]	10
Peer education principles[4,8,9,23,32,39,40]	7
Culture-sensitivity[11,12,14,23,33,34]	6
Understanding of the context in which behavior changes take place[4,8,21,23,33,30]	6
The active role of recipients[4,12,25]	3
Motivational interview[25,30,37]	3

Table 5. Examples of the most often reported BCTs.

BCT	***n***
Self-monitoring[3,4,6–8,12–14,16,18,19,21,22,25,27–32,37,39]	24
taking clinical measurements: blood sugar and blood pressure[2,6,15,16,19,28,30,39]	
monitoring of symptoms and health behavior related to the	

assessed goals[4,7,28,29]	
using self-management monitors: blood glucose, blood pressure and pedometers [12,14,22,29,30,39]	
Goal setting[3,7,8,15,16,18–20,21,25,27–29,32–34,35,37,38]	20
Information providing[6,8,11,14,15,17,19,21,22,25,28,30–32]	17
Individual action plans to support health-related behavior[6,10,11,14,19,20,29,31–33,38,39]	12
Enhancing participants' social support[6,7,15,16,18,22,23,25,29,32,40]	11
Practicing problem solving techniques[2,6,7,15,18,19,28,29,32,37]	10
Possibilities to tailor intervention activities towards participants' personal needs[11,14,18,28,30,31,33,38–40]	10

Table 6. Original studies that reported outcomes of NB and/or PA

Original paper	Theory	Format	Individual / Group	Additional info	Number of BCTs	Frequency	Length + follow-up (month)	Improvment in NB	Improvment in PA	Improv-ment in CM
(7) Lynch et al., 2014	Models of behavior change	Telephone calls Education lectures	Individual + group	18 group sessions by dietitian and LHW weekly for three months, afterwards every second week; phone calls weekly by LHW	9	weekly	6	yes	yes	yes / no
(15) Rothschild et al., 2014	Self-management theory	Home visits Telephone calls	Individual	36 home visits	7	monthly	24	no	no	yes / no
(17) Spencer et al., 2011	Empowerment theory	Education lectures, Home visits, Accompanied clinic	Individual	Group session once every two weeks Telephone calls once	4	weekly	6	no	yes	yes / no

		visits, Telephone counselling, Peer activities		every two weeks						
(21) van der Wulp et al., 2012	Social cognitive theory	Home visits, Education lectures, Telephone counselling, Emails	Individual	Monthly meetings, Telephone calls two weeks after meetings. Plus calls and emails when needed.	5	two weeks	18	yes	no	-
(23) Assah et al., 2015	Socioculturally adapted community-based approach	Group meeting, Individual appointments, Telephone counselling, Home visits	Individual + group	Six group meetings, personal encounters, telephone calls (five calls)	3	monthly	6	yes	yes	yes

(25) Castillo et al., 2010.	Empowerment theory, Adult education	Group meeting, Individual appointments, Education lectures	Individual + group	Ten group education sessions + individual contacts between sessions	9	weekly	2.5	yes	yes	yes / no
(26) Cene et al., 2013	Community capacity building	Group meeting, Education lectures	Group	Group meetings weekly for six weeks, then monthly,12 sessions total	2	six times weekly, afterwards monthly	7.5	-	no	no
(29) Dye et al., 2015	Transtheoretical model of change	Group meeting, Education lectures	Group	Self-management curriculum: 7 meetings plus additional lectures on NB or PA	8	weekly	4	yes	yes	yes
(30) Fernandes et al., 2012	Transtheoretical model of change	Group meeting, Education lecture, Peer work shop	Group	Group meetings, afterwards monthly meetings up to 12 months	9	11 times weekly, afterwards monthly	12	yes	yes	yes / no

(31) Islam et al., 2013	Community-based approach	Group meeting, Individual appointments, Education lectures, Make-up sessions	Individual + group	six monthly group meetings plus individual meetings at months 3, 6, and 9	4	monthly up to 6 months, individual at 9 months	9	yes	yes	no
(32) Lorig et al., 2013	Self-efficacy theory	Online group meetings, Education lectures, Weekly activities	Online: Individual + group	Online program	15	available every day	1.5 + 12	-	yes	-
(33) Micikas et al., 2015	Stages of change, Health belief model	Group meetings, Education lectures, Home visits	Individual + group	Individual home visits, group meetings	7	weekly	4	-	no	yes
(37) Saxe-Custack et al., 2013	Community-based approach	Group meetings, Individual appointments,	Individual + group	four individual weekly meetings at home, afterwards six home	9	weekly	2.5 + 6	yes	no	yes / no

	Education lectures, Home visits	visits or group meetings weekly

NB = nutrition behavior

PA = physical activity

CM = clinical measurements

- = was not measured

Table 7. Outcomes in nutrition behavior and physical activity and their links to intervention components and clinical measurements

Measured outcome	**Type of effect**	**Original paper**	**Formats**	**BCTs**	**Clinical measurements** +improvement –no improvement
NB + PA	NB + PA improved	7	Telephone calls + Education lectures	9: Goal setting, motivating, emotional support, teaching problem-solving techniques, enhancing social support, self-monitoring, role	+HbA1C

		(individual + group)	model narratives, hands-on activities, taking and monitoring clinical measurements	+Weight loss -Blood lipids -Blood pressure
	23	Group meeting + Individual appointments + Telephone counselling + Home visits	3: Teaching self-management skills, enhancing social support, discussion	+HbA1C +Blood lipids +Blood pressure +BMI +Fast BC +Waist circ +Weight loss
	25	Group meeting + Individual appointments + Education lectures	9: Goal setting, self-efficacy support, motivating, teaching self-management skills, enhancing social support, support decision making, information providing, self-monitoring, hands-on activities	+HbA1C +Blood pressure -Weight loss
	29	Group meeting + Education lectures (group)	8: Goal setting, self-efficacy support, teaching problem-solving techniques, enhancing social support, action plans, self-monitoring, personal health diary, taking and monitoring clinical measurements	+Blood pressure +Fast BC +Weight loss +Blood lipids

	30	Group meeting + Education lectures (group) + peer work shop	9: Information providing, self-monitoring, using written counselling materials, reminders, tailoring, hands-on exercises, taking and monitoring clinical measurements, healthy snacks, incentives	+Blood lipids +Fast BC -HBA1c -Blood pressure -BMI
	31	Group meeting + Individual appointments + Education lectures + Make-up sessions	4: Information providing, action plans, self-monitoring, tailoring	-Blood lipids -HbA1c -Blood pressure -BMI
NB improved	21	Home visits + Education lectures + Telephone counselling + emails	5: Goal setting, self-efficacy support, motivating, information providing, self-monitoring	NR
	37	Group meetings + Individual appointments + Education lectures + Home visits	9: Goal setting, motivating, teaching problem solving, teaching relapse prevention, information providing, self-monitoring, tailoring, guest speakers, hands-on exercises	+HbA1C +BMI -Blood pressure
PA improved	17	Education lectures + Home visits + Accompanied clinic visits	4: Self -efficacy support, keeping appointments, information providing, hands-on exercises	+HbA1C +Blood lipids

					-Blood pressure -BMI
	no improvements	*15*	*Home visits + Telephone calls*	*7: Goal setting, teaching self-management skills, teaching problem-solving techniques, enhancing social support, information providing, using metaphors, taking and monitoring self-management skills*	*+HbA1C* *+Weight loss* *-Blood lipids* *-Blood pressure*
PA	improved	32	Online group meetings + Education lectures + Activities	15: Goal setting, self-efficacy support, teaching self-management skills, emotional or behavioral support, teaching problem-solving skills, sharing feelings, enhancing social support, stress managements, information providing, action plan, self-monitoring, feedback, discussion, role model narratives, hands-on exercises	NR
	no improvements	*26*	*Group meeting + Education lectures*	*2: Guest speakers, taking and monitoring clinical measurements*	*-Blood pressure* *-Fasting BC* *-Weight loss* *-Blood lipids* *-HbA1C*
		33	*Group meetings + Education lectures + Home visits*	*7: Goal setting, emotional and behavioral support, action plans, reminders, discussion, tailoring, hands-on exercises*	*+HbA1C*

Implementation and Outcomes of Lay Health Worker–Led Self-Management Interventions for Long-Term Conditions and Prevention: A Systematic Review

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Abstract

The aim of this study was to systematically review lay health worker (LHW)-led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of research findings, taking into consideration the intervention components that have been applied.

We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria: self-management with diabetes (n = 29), cardiovascular diseases (n = 8), and those at risk of cardiovascular diseases (n = 3). These consisted of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions.

The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects.

Keywords: lay health worker, long-term condition, self-management, intervention component, behavior change technique, systematic review

Introduction

Non-communicable diseases (NCD) are long-term conditions (LTC) that require ongoing self-management over a period of years as individuals learn to manage their health challenges (Eaton, Roberts, & Turner, 2015; Taylor et al., 2014; Nolte & McKee, 2008). The self-management of LTCs has been defined as a daily and flexible process where an individual, as a responsible actor, is able to perform individual goal-driven activities (Lorig & Holman, 2003; Ausili, Masotto, Dall'Ora, Salvini, & Di Mauro, 2014), such as adopting information, drug and symptom management, and adjustment to psychological consequences such as emotions and stress (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002).

Acquiring and applying individual skills related to self-management components demands effort from patients, peers, and health professionals (Kaptein, Fischer, & Scharloo, 2014; Kawi, 2012). People's beliefs that they can cope in their everyday activities and meet the challenges of self-management have been labelled as self-efficacy (Bandura, 1977; Vervekina, Shi, Fuentes-Caceres & Scanlon, 2014). Self-management interventions provide support to modify one's decisions and behavior for a healthier lifestyle. Interventions usually include a variety of observable and replicable behavior change techniques (BCT), such as goal setting, action planning, and self-monitoring (Michie et al., 2013; Duff et al., 2017).

The self-management of LTC has been supported by peers (Tang, Funnell, Gillard, Nwankwo, & Heisler, 2011; Dale, Williams, & Bowyer 2012; CADTH, 2013), who are usually people with the same diagnosis or health condition as the people they assist (Lorig & Holman, 2003; Carr et al., 2011; van Ginneken et al., 2013). Lay health workers (LHW) as LTC self-management supporters are especially able to share values, socioeconomic status or cultural background and, in some cases, also the experience of LTC (South, Meah, Bagnall & Jones, 2013; Hunt, Grant, & Appel, 2011; Islam et al., 2015).

LHWs act as peer supporters, educators, role models, and community capacity builders (South et al., 2013). LHWs have been shown to improve equity in health care services by reaching underserved people with a poorer health status (Walker & Jan, 2005; Shah & Patel, 2013). There has been a wide variety of LHW training in terms of duration and methods (O'Brien, Squires, Bixby, & Larson, 2009; South et al., 2013).

The effectiveness of LTC self-management interventions has been measured through individuals' knowledge, psychological state, behavior, and clinical outcomes (Dube, Van de Broucke, Housiaux, Dhoore, & Rendall-Mkosi, 2015). Lay-led self-management programs for those with chronic conditions may improve short-term self-management outcomes, such as physical activity (PA) and self-efficacy (Foster, Taylor, Eldridge, Ramsay, & Griffiths, 2009). Previous systematic reviews of LHW interventions for diabetes found that (a) LHWs' roles in individuals' self-management counseling were diverse in their ways to support, educate, advocate, and facilitate, and (b) interventions were partially effective in improving HbA1C levels and health behavior outcomes (Hunt et al., 2011; Little, Wang, Castro, Jimenez, & Rosal, 2014). Carr et al. (2011) investigated connections between the implementation of interventions and their outcomes, but found no firm relationships between them.

However, in this study we systematically reviewed previous LHW-led self-management interventions for adults with LTCs in terms of the implementation of interventions. The first objective was to investigate those characteristics of LHWs and their training that have been reported within the context of self-management. The second objective was to investigate the implementation of interventions. The third objective was to investigate what kind of relationships, if any, there are between intervention components and nutrition behavior (NB) and PA outcomes.

Methods

Search strategies and selection criteria

The present review was conducted according to standard systematic review methodology (CRD, 2009) and reported according to the PRISMA Statement (Liberati et al., 2009). A systematic search for articles, reported full text in English (due to limited facilities and resources for translation) and published between 2010 and 2015, was undertaken in five databases between December 2015 and January 2016: Cochrane, MEDLINE, CINAHL, PsycINFO, and Web of Science. Search terms included Community Health Worker* OR Lay health* OR Lay supporter* OR Lay tutor* OR Advisor* OR counsellor* OR counselor* OR peer OR peer counsellor* OR peer counselor* OR peer-advisor* OR peer-coach* OR peer-counsellor* OR peer-counselor* OR peer-educator* OR peer-led* OR health trainer* AND Self-Management OR Self care. Both MeSH and free-text terms were used. The full search strategy is available from the authors on request.

One of the authors extracted ~~independently t~~he following data independently and discussed it with the other researchers who were involved with study selection. Disagreements between reviewers were resolved by consensus. The following inclusion criteria were applied: adults as recipients; non-communicable and somatic diseases or their prevention ~~of them~~; LHW-led self-management intervention; organized by primary health care, community health center or corresponding organization; RCTs and quantitative trials. The exclusion criteria were the following: studies that reported outcomes of LHWs' own self-management; intervention was led by non-trained peer supporter; family interventions; cancer, HIV, asthma or mental health self-management interventions; review papers; study protocols; and papers presenting baseline results only (Figure 1).

All of the included studies deal with self-management of diabetes and cardiovascular diseases. Both diseases, as long-term somatic and non-communicable conditions, can largely be prevented or treated by allied self-management activities covering certain daily behavioral and psychological actions taken by individuals. NB and PA are key self-management activities when dealing with type 2 diabetes and cardiovascular diseases on a daily basis (WHO, 2013; Donaldson & Rutter, 2017). In addition, there is a vital need for research with a scope that combines self-management and prevention in both diabetes and cardiovascular diseases. The quality of the included studies was assessed using the 14-item checklist from the Manual for Quality Scoring of Quantitative Studies with a range of 0–28 points (MQSQ; Kmet, Lee, & Cook, 2004). The quality evaluation was conducted by the first author, and the decisions have also been discussed with two other authors.

Analysis

The analysis of the first and second objectives ~~of the current study aimed to investigate~~ concerned the contents of LHWs, their training and LHW-led self-management interventions. The interventions' components were classified according to their formats (e.g., group, individual, telephone, home visit), elements (e.g., lectures, PA classes; Davidson et al., 2003), and BCTs (Michie et al., 2013). ~~For the first and the second research objectives,~~ The data were analyzed using content analysis (Schreier, 2012) by identifying the units of meaning, condensing them and finally creating subcategories. Based on similar subcategories, eight main categories were composed: (1) characteristics of LHWs, (2) training of LHWs, (3) intervention delivery by LHWs, (4) theoretical background and guidelines of the interventions, (5) principles of implementation, (6) intervention formats and

elements, (7) behavior change techniques, and (8) intervention management and mediators. (Table 1.)

For the third objective of the review, self-management was investigated as a behavioral outcome of NB and PA in 13 original studies that measured them. The analysis was conducted by identifying the components and clinical measurements and their links to NB and PA. The data within these analyses was relatively narrow, however, it was eventually grouped according to their improvements in NB and PA and those groups were compared. This review describes and identifies the intervention features that indicate participants' behavior changes within the original studies.

All of the following aspects in the fields of NB and PA and clinical measurements were manually coded and categorized in Microsoft Excel: the reported intervention formats and elements, such as delivery in group or individual sessions, telephone or online contact, and education lectures (Davisdon et al., 2003); behavior change techniques (applied by Michie et al., 2013); intervention length and frequency; significantly improved and not improved self-management outcomes in terms of PA and NB; and clinical measurements.

This semi-qualitative metric was developed in the current study to extract and investigate the ~~connections~~ links between intervention components and PA and NB. Additionally, there were a large variety of measurements ~~number of different scales and measures~~ used to assess PA, NB, blood lipids, and blood pressure as self-management outcomes, which were difficult to bring together. Therefore, all of the tests that investigated similar items ~~needed to be~~ were classified as items of self-management (Table 2) in order to allow the data to be analyzed and for the results to be explained based on the study topic. All of the results are based on the published study results, and no original study data or intervention material have been examined.

Results

Included studies

The included studies ($n = 40$) originated from seven countries, most of them from the United States ($n = 31$). Twenty-nine studies examined self-management in diabetes, eight in cardiovascular diseases, and three in a risk of cardiovascular diseases. The included studies consisted of 22 randomized controlled trials and 18 other trials. The methodological quality of the studies ranged from 9 to 25 points, with a total possible MQSQ sum of 28 points (9–12 points, 5 studies; 13–20 points, 23 studies; 21–25 points, 12 studies; see Table 3). Points were typically subtracted due to an absence of randomization or blinding, or due to a lack of reporting about them. No original studies were excluded, since the focus of the review was on qualitative description of LHWs and interventions. Additionally, MQSQ does not set any score limits for the appropriate level of study quality.

The durations of the self-management interventions varied from one day to 24 months. The number of baseline recipients in all the included studies was 10,065 (female 55%) and follow-up 7,970, with a total attrition rate of 21%. The studies varied largely in their reporting. For example, in some papers the background, training, and duties of LHWs as well as intervention details were clearly presented, and in others they were not. Due to the high number of studies included in the current review, the original studies will be cited according to the numbers referred to in Table 3.

Characteristics of LHWs and their training

The individual skills and characteristics often included having the similar health condition or experience of it as the participants had[8,10,12,16,20,21,32,38]. LHWs came from the same community as the recipients did[6,8,26], and some of them also had a professional background[24,26]. Many of the studies were located in minority communities, therefore LHWs were often bilingual, combining, for example, Spanish and English[11,25,27,30,31].

Training educators were revealed to be health professionals[7,14], specialists[1,28], or university researchers[25,29]. ~~Besides of self-management-related themes[2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40],~~ **Training content** consisted of using community resources, navigating health care services, and organizational issues.[5,8,9,12,16,18,20,22,29] (See Figure 2.) Additionally LHWs' training also included themes of supporting effective self-management techniques, such as motivational, self-monitoring and measuring [2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40], alongside clinical protocols [8,11,16,25,34,35], medication [9,20,34] and self-care routines [9,16]. The training **elements** varied from, for example, classroom activities[8,28,38,40] to home visits[9]. The LHWs were also trained in research practices[2,5,8,12,16,25,28,38], protecting human subjects[5,18,25], and cultural awareness[5,18].

The number of LHWs within one intervention varied from 1[14] to 41[16]. LHWs had **multiple roles and duties related to intervention components.** Between the education sessions, LHWs contacted participants to provide support or to answer their questions[1,7,17,25,35,39]. They were also available for recipients' phone calls.[1] In a few interventions LHWs worked as equal members of health care teams[5,11,12,24,27,29,30,33,34,40].

LHWs also collected research data [1,25,31], contributed to intervention evaluations[25], and acted as a team leader for a group of LHWs.[4,26,39] Some studies reported **supervision provided to LHWs** by program coordinators[3,4,5,8,9,20,37], nurse care managers[2,3,28], health

care teams of community centers[5,37], and university professionals[37]. In some cases, LHWs were provided with a written manual to ensure consistency of delivery.[37,38,40] They consulted with health professionals on any serious symptoms or for measurements of recipients.[11,12,27,32]

Intervention delivery of LHW-led interventions

Nearly half of the 40 studies reported no **theoretical background** for the intervention or program[3,4,6,9,10,12,13,16,18-20,24,26,27,34-36,39], but some did (Table 4). In eight studies the theoretical background was presented as a combination of two theories[5,8,11,23,25,33,38,40]. The framework of an intervention's content or its components was often based on **national guidelines and recommendations** on diabetes[1,2,5,11,12,14,15,26,27,32,35], hypertension[8,29], or cardiovascular diseases[30,39].

Meetings usually **took place** in community centers and churches, often held at a convenient location to the recipients[1,2,4,22,23,25–27,31]. **The length** of sessions, when reported, ranged from 30 to 90 minutes.[26,27,29,37] **Group sizes** varied from two[24,38] to twenty-five[32] participants. In a few interventions the interaction frequency was based on the needs of peers and recipients.[2,21]

LHWs delivered educational activities for individuals or groups, including making action plans, motivating, problem solving, and self-management guidance with support given either face to face by telephone [2,4,5,7,9,10,15,17,22,24,25,27,28,29,33,34,39,40], or online [32]. Home visits were also conducted [11,17]. Some of the LHWs assessed goals [39], provided confidant information [29], or helped patients to understand their long-term conditions and self-management [2,9,25].

All together, the studies reported thirty-five separate **health behavior change techniques** being applied (Table 5).

Recruitment of potential individuals to participate in interventions was conducted at hospitals, health centers, community centers or churches[6,7,8,12,15,34,35], or via the media, websites or seminars[15,22,32]. To ensure **fidelity of program delivery**, classes were monitored[16,22] or audio recorded[12], checklists were completed[21] or activity reports were submitted[22]. Interventions acted as **bridges to local health and social services** by encouraging participants to continue with their health care services[3,5,6,14,16,17,18,19,21,22,28,31,37,38,39]. **Attrition prevention** was performed by implementing make-up sessions[31], providing cash incentives, stipends or gift cards[14,19,20,37,39], and making telephone support calls to recipients who did not attend the sessions[18].

PA and NB outcomes in the LHW-led interventions

Statistically significant improvements (minimum of $p < .05$) in all self-management outcomes, including psychological, behavioral, and clinical outcomes, were reported in many studies. Because our review concentrated on behavior, the outcomes of PA and NB as self-management activities, and their links ~~connections~~ to clinical outcomes, are presented. Ten studies measured both PA and NB, and three studies measured only PA (see Table 6). Measurements of the studies were mostly pre- and posttest, with only two studies having follow-ups[32,37].

Out of ten studies that investigated both PA and NB, six ~~interventions improved~~ reported both improved PA and NB[7,23,25,29–31], two ~~interventions~~ reported improved NB[21,37], one reported improved PA[17], and one found no improvements[15]. NB- and PA-effective

interventions were organized into groups, and four of ~~them~~ these had additional individual activities.[7,23,25,31] Their length varied from two-and-a-half months[25] to 12 months[30]. Four of them provided activities weekly, and five had education lectures. Their number of identified BCTs were eight[29] or nine[7,25,30]. Three of the NB- and PA-effective interventions also improved clinical measurements such as HbA1C[7,23,25], blood pressure[23,25,29], blood lipids[23,29,30], and weight loss[7,23,29], and one[31] found no clinical improvements. (Table 7)

The current review also aimed to identify PA- and NB-effective interventions separately to get more accurate results concerning behavior change in LHW-led self-management interventions. In PA-effective interventions[7,17,23,25,29–32] the number of applied BCTs varied from three to fifteen. In ~~part~~ some of the interventions, group meetings were combined with individual face-to-face meetings, at recipients' homes, or via telephone. In PA-ineffective interventions[15,21,26,33,37] the intervention components were mainly similar to effective PA interventions, with two of them providing only individual meetings. The number of BCTs ranged from two to nine. Regarding the high number of applied BCTs, certain remarks appeared in terms of PA as a form of self-management activity ~~(Figure 3).~~ Self-monitoring, enhancing social support, hands-on activities, and self-efficacy support were mainly ~~connected~~ linked to improvements, whereas goal setting was ~~connected~~ linked to both improvements and no improvements. Increased PA was often related to positive effects on clinical measurements, but not in all cases.

In NB-effective interventions[7,21,23,25,29-31,37] the number of BCTs was from three to nine, with some variations in techniques, theoretical backgrounds, and durations. In those studies, it was more likely that self-monitoring, goal setting, and motivation were used as BCTs. ~~(Figure 4.)~~ For example, information providing ~~was~~ had been used in four studies where NB improved but also in both studies where no improvement was found. When measured alongside NB,

many studies also found positive effects on clinical measurements. Nevertheless, despite the improved NB, blood pressure was more likely to increase than decrease.

Discussion

The current review found that LHW-led self-management interventions have potential in promoting self-management in LTC. The implementation of interventions varied widely. Only about one third of the studies investigated NB and PA as indicators of behavior change, however, some of those that did had found positive outcomes.

The findings show that LHWs were often themselves trained LTC patients, who were personally interested in acting as LHWs. This study restates the previous descriptions of LHWs (Hunt et al., 2011; South, Kinsella & Meah, 2012; South et al., 2013), who are considered to be trained peer workers, as having similar cultural, ethnic or health backgrounds to their clients. LHWs' roles were identified as educators, supporters, opinion leaders, organizers, and acting as bridges between communities, professionals, and clients. Interventions typically encompassed empowerment, social support, and tailoring-oriented principles, and they varied widely in length, frequency, and components. For example, group sessions, education lectures, and individual appointments were common formats, whereas self-monitoring, goal setting, information providing, action plans, and social support were frequently applied BCTs. Similar formats and BCTs were often applied in effective as well as in non-effective interventions.

The implementation of and reporting on both LHW training and LHW-led interventions diverged, as has been shown in previous studies (Hunt et al., 2011; Shah et al., 2013). A number of interventions lacked a theoretical background, or at least did not report one (Hunt

et al., 2011; Dale et al., 2012), which is a common issue in evidence-based health promotion. Implementation quality was assured in many interventions by providing continuous supervision during the intervention process (Hunt et al., 2011). That can be considered as a way to empower LHWs to be self-management tutors, and also assist them in cooperating with each other. As a non-professional workforce, they may benefit from organizational support for their work.

Interventions often followed national recommendations or guidelines for particular LTCs, as well the program for chronic disease self-management (Lorig et al., 2013). However, the current review highlights self-management as a person's own activities and emotions for taking care of a LTC by, for example, setting and modifying goals, solving problems, relying on peer support, and action planning (also Richardson et al., 2014). It seems that part of the interventions emphasized lecturing and giving advice, while many interventions consisted of behavioral and emotional elements that supported self-management (also Kawi, 2012; Lorig, Ritter, Ory & Whitelaw, 2013; Kaptein, et al., 2014). Effective self-management support should correspond to recipients' unique needs as well as assist individuals in strengthening their motivation and skills in coping in daily life with an LTC (Newbould, Taylor, & Bury, 2006). However, participants who lack knowledge and others with low self-efficacy may fail to benefit from similar activities and support in improving their self-management. These demands have been responded to in many interventions by tailoring intervention activities according to individual participants' requirements.

This review had similar findings to previous work, in that LHW-led self-management interventions can be effective in HbA1c (Hunt et al., 2011; Dale et al 2012; Little et al., 2014), and in a few interventions in PA, NB, blood pressure, and blood lipids (Hunt et al., 2011; Dale et al., 2012). Even though the same components and BCTs led to both significant and non-significant outcomes, some preliminary but not robust ~~connections~~ links were

observed. Group meetings and enhancing social support seemed to be particularly effective in improving PA. This reflects earlier findings (Greaney et al., 2017) and also highlights the need for social activities and for sharing motivation and feelings with LHWs and other recipients when improving one's PA. Furthermore, self-monitoring and hands-on activities and exercises as self-management actions were more likely ~~connected~~ linked to both improved PA and NB. Regarding the findings of generally applied BCTs in PA interventions (Duff et al., 2017), goal setting did not appear as an effective BCT at this time. However, in terms of behavior change interventions, only about one third of the studies measured NB and/or PA as an outcome of behavior change. In considerations of behavior changes among long-term patients, measuring their health behavior may provide beneficial knowledge on how patients manage with self-management in the context of their daily lives. Both research and clinical practice would benefit from this information.

Thus, a particular intervention component does not consistently lead to improvements. Firstly, identifying and understanding (Johnston et al., 2017) formats and BCTs and, second, applying them in self-management interventions are demanding processes, especially deciding how to maintain techniques based on recipients' unique needs, such as motivation or making action plans. When the training periods of LHWs last from days to months, it may have been challenging to learn the further ethos of the BCTs that were applied. In a portion of the interventions it remained unclear how the LHWs were trained in BCTs. Furthermore, based on the results of this study, it is possible that other intervention components, such as intensity (Palmas et al., 2015), duration, and overall personal interaction between LHWs and participants may play a role in effective interventions.

Nevertheless, as this review suggests, LHWs may have particular potential in self-management interventions among cultural and lingual minorities due to their reciprocal ability to share culture and experiences. They may have the potential to increase vulnerable individuals' involvement in services but also to promote self-management and health behavior change.

Limitations and strengths

The collected data enabled specific examinations of LHW-led self-management interventions, yet the current study has its limitations. The study protocols differed, combining RCT and trials with a variety of study participants. Due to the high variability and high numbers of different BCTs and self-management outcomes reported within the data, the evidence for making ~~connections~~ links between techniques and outcomes is limited. However, only the most ~~obvious findings~~ prominent themes are presented in this paper. The heterogeneity across interventions and outcomes ~~variation~~ may also ~~cause~~ lead to limitations in identifying the intervention components (Abraham et al., 2015; Johnston et al 2017) and determining the results of this review, which itself contains reviews by Carr et al. (2011) and Little et al. (2014). The recipients of the original studies often represented cultural or linguistic minorities or low-income groups, so the results may not be transferable to other groups. In addition, there may be a risk of language bias because the included studies had to be reported only in English (CRD, 2009). Nevertheless, to our knowledge, the major studies regarding the topic have been conducted in an international context and reported in English.

This study has three primary strengths. First, it sets out a systematic synthesis of the characteristics and training of LHWs, the implementation and components of LHW-led interventions, and BCTs. The synthesis could serve as a framework for future research and

clinical practice considering LHW-led self-management interventions. Second, it contains a number of original studies that provide robust data on LHW-led self-management interventions among people with diabetes and cardiovascular disease. Third, it presents preliminary ~~connections~~ links between intervention components and outcomes in the field of LHW-led self-management interventions. To our knowledge, there is currently only scant evidence of such a ~~connection~~ link.

Implications for Policy and Practice

LHW interventions, as a mode of health services for multiple groups of people, have the potential to improve self-management for those with diabetes, cardiovascular diseases and chronic conditions as well as assist ~~aid~~ in prevention. LHW-led services in self-management support may reach people who are vulnerable or underserved. However, to improve self-management in LTC, systematic training in adopting and applying formats and BCTs should be provided to LHW candidates. In the future, an evidence-based standard for LHW training and interventions may be formulated for the field of LHW self-management interventions and their investigation. Such a standard, however, requires further research on its implementation.

Another suggestion for further research on self-management outcomes of LHW interventions would be to examine whether interaction frequency, meeting minutes, or group size have effects on self-management and, if so, what are the mechanisms that make them effective. A further line of study could determine how different combinations of intervention formats and BCTs interact.

Additionally, promoting recipients' self-regulation strategies or improving their psychological flexibility as stages of health behavior change may offer new ways to achieve goals in LHW interventions. In summary, the results of this review suggest that LHW-led self-management interventions for diabetes and cardiovascular diseases have been implemented in multiple ways, and these interventions have seemed to improve, at least partially, behavioral and clinical self-management outcomes.

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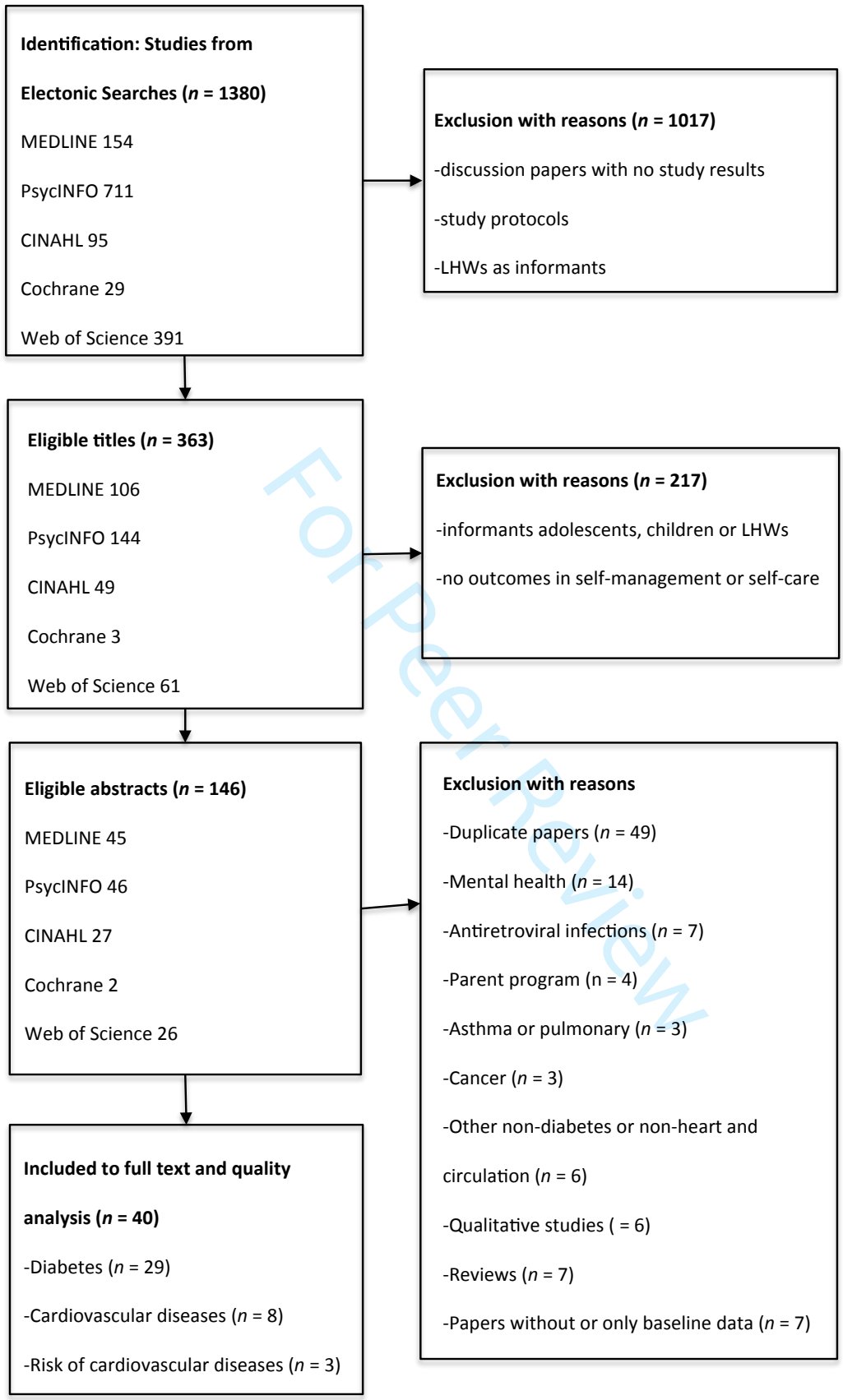

Figure 1. Flowchart of the searches.

Table 1. Example of the content analysis phase concerning LHW characteristics

Examples of the original expressions	Condensed expression	Subcategory	Main category
[The facilitators were six lay people with experience of heart disease, either personally -- or as carers of people with heart disease. 3.10]	The facilitators were six lay people with experience of heart disease self-management	Background and experience	Characteristics of LHWs
[The CHWs had an average of 6 years' experience leading DSME at CHASS. 18.22]	The CHWs had an average of six years' experience in leading diabetes self-management programs		
[--co-delivered by -- a patient (lay) tutor who had experience in these services 40.11.1]	Patient lay tutor had experience of services related to self-management support		
[-- an organization devoted to the education of people with diabetes and health care team members, on the basis of their excellent diabetes control, self-motivation, communication and support skills and interest. 4.21]	On the basis of their excellent diabetes control, self-motivation, communication and support skills and interest.	Eligibility criteria	
[simply interest of being a diabetes educator 24.9]	Simply one's own interest of being a diabetes educator		

[someone with diabetes or with a family member or friend with diabetes 24.8]	Having diabetes her/himself or a family member who has		
[16 hours training by the project manager or principal investor. 1.14]	Training provided by the project manager or principal investor	Training educators	LHWs' training
[The trainings were delivered by an interdisciplinary team of academics and practitioners with expertise in clinical medicine, health inequities, Latino health, diabetes self-management, diabetes medications, nutrition, exercise, cross-cultural counseling, and mental health. 11.27]	The culturally sensitive training delivered by an interdisciplinary team of academics and practitioners		
[CHWs trained by research staff from the University of Illinois at Chicago (UIC) 25.2.1]	CHWs trained by research staff from the University		
[to teaching blood pressure and glucose readings 1.18]	Training prepared CHWs in teaching blood pressure and glucose readings	Training purposes	
[building and reinforcing the participants' knowledge on diabetes, 23.22]	Building and reinforcing the participants' knowledge on diabetes		
[We trained community volunteers to be "Health	To train community volunteers to be health coaches		

Coaches" for our project -- 29.34]

Table 2. Examples of self-management outcomes transferred to self-management items

Item of self-management	**An example of original self-management measurement**
Physical activity (PA)	Summary of Diabetes Self-Care Activities measure[7]*
	Moderate levels of physical activity 30 min per day at least 5 days per week[17]
	Physical Activity Scale for Elderly[21]
	Survey of Diabetes Self-Care Activities: Exercise[23]
	Minutes of daily physical activity[25]
	Questionnaire on physical activity[37]

Nutrition behavior (NB)	Number of days to follow a diet[7]
	Amount of daily servings of vegetable and fruits[17]
	Survey of Diabetes Self-Care Activities: Nutrition[23]
	Following a healthy eating plan, eating fruits/vegetables[25,30]
	Self-reported eating behavior[29]
	Questionnaire on nutrition[31,37]
Blood lipids	HDL[23,30,35] LDL[17,30]
	Total cholesterol[23,30] Triglycerides[30]
Blood pressure	Systolic[23,25,29]
	Diastolic[23]

*References in Table 3.

Table 3. Studies included in the analysis

Number	Original Paper	Purpose of LHW intervention	Field	Method	Main outcome, analysis	Setting	Follow-up, *N* =	Format (briefly)	Months of duration + follow-up	Quality assessment score
1	Daniels, E., Powe, B., Metoyer, T., McCray, G., Baltrus, P., & Rust, G. (2012). Increasing knowledge of cardiovascular risk factors among African Americans by use of community health workers: The ABCD community intervention pilot project. *Journal of the National Medical Association*, *104*(3-4), 179–185. USA	To increase knowledge of cardiovascular risk among African-Americans	CVD	RCT	Knowledge of CVD, health literacy, Depression, HBA1C, BP, cholesterol, BMI, waist circumference *t* tests	Church	25	Group meeting Telephone counselling	1.5	17
2	DePue, J., Dunsiger, S., Seiden A., Blume, J., Rosen, R., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S. (2013). Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial.*Diabetes Care, 36*(7), 1947–1953.	To support diabetes self-management among American Samoans	T2DM	RCT	HBA1C, BP, BMI, waist circumference, dietary intake Wilcoxon, *t* test, mixed effects	CHC	243	Group meetings Individual meetings	12	22

	American Samoa, USA				longitudinal regression model					
3	Furze, G., Cox, H., Morton, V., Chuang, L-H., Lewin, R.J.P., Nelson, P., Carty, R., Norris, H., Patel, N., & Elton, P. (2012). Randomized controlled trial of a lay-facilitated angina management programme. *Journal of Advanced Nursing, 68*(10), 2267–2279. England	To assess the effectiveness of a angina management program	CVD (Angina manage-ment)	RCT	Angina frequency (1-week angina diary) Negative binomial, linear and logistic regression	Home-based	124	Individual interview Home visits Telephone calls	3	20
4	Gagliardino, J.J., Arrechea, V., Assad, D., Gagliardino, G.G., González, L., Lucero, S., Rizzuti, L., Zufriategui, Z., & Clark, C Jr. (2013). Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals.*Diabetes/Metabolism Research & Reviews, 29*(2), 152–160. Argentina	To compare standard care and the care and ongoing support of trained peers for people with T2DM	CVD (Hyper-tension)	RCT	HBA1C, BMI, BP, cholesterol, attitudes regarding diabetes and their care Chi-square test, *t* test	Health education center	198	Peer support group Face-to-face visits Telephone communicatio n	1.5	15

5	Hargraves, J.L., Ferguson, W.J., Lemay, C.A., & Pernice, J. (2012). Community health workers assisting patients with diabetes in self-management. *Journal of Ambulatory Care Management, 35*(1), 15–26. Massachusetts, USA	To integrate community health workers into work with diabetes type 2 patients and support diabetes self-management	T2DM	RCT	HBA1C, cholesterol, BP, self-management Hierarchical regression, logistic models, correlations	CHC	1,415	LHW in health care teams	13	9
6	Kronish, I.M., Goldfinger, J.Z., Negron, R., Fei, K.Z., Tuhrim, S., Arniella, G., & Horowitz, C.R. (2014). Effect of peer education on stroke prevention: The Prevent Recurrence of All Inner-City Strokes Through Education (PRAISE) randomized controlled trial. *Stroke*, *45*(11), 3330–3336. New York City, USA	To determine the effect of peer education on secondary stroke prevention	CVD (Stroke)	RCT	BP, cholesterol, use of antithrombotic medications, control of the stroke risk factors *t* test for continuous variables, χ^2 analysis for categorical variables, mixed models	Primary health care	510	Group meetings	1.5 + 6	20
7	Lynch, E.B., Liebman, R., Ventrelle, J., Avery, E., & Richardson, D. (2014). A self-	To determine the effectiveness of	T2DM, CVD	RCT	Medical history, clinical variables,	Communit y setting	55	Group sessions	6	19

	management intervention for African Americans with comorbid diabetes and hypertension: A pilot randomized controlled trial. *Preventing Chronic Disease*, *11*, 130349. Chicago, USA	comorbid diabetes and hypertension self-management intervention for African Americans	(hypertension)		BMI, medications, dietary intake, PA, health literacy, nutrition knowledge and quality of life *t* tests, χ^2 tests, Fisher's exact test, continuous variables, Wilcoxon rank-sum test			Telephone calls		
8	Martin, M.Y., Kim, Y.I., Kratt, P., Litaker, M.S., Kohler, C.L., Schoenberger, Y.M., Clarke, S.J., Prayor-Patterson, H., Tseng, T.S., Pisu, M., & Williams, O.D. (2011). Medication adherence among rural, low-income hypertensive adults: a randomized trial of a multimedia community-based intervention. *American Journal of Health Promotion, 25*(6), 372–378. Alabama, USA	To examine the effectiveness of community-based multimedia intervention in medication adherence among hypertensive patients	CVD (hypertension)	RCT	Pill count Means, standard deviations, frequencies. χ^2 analysis, general linear model	Online, CHC	338	Online program Home visits Telephone calls	6 + 6	16

9	McDermott, R.A., Schmidt, B., Preece, C., Owens, V., Taylor, S., Li, M., & Esterman, A. (2015). Community health workers improve diabetes care in remote Australian Indigenous communities: results of a pragmatic cluster randomized controlled trial. *BMC Health Services Research*, *15*, 68. Australia (north)	To test the effectiveness of a community-based approach to intervention for indigenous adults with poorly controlled T2DM in Australian indigenous communities	T2DM	RCT	HBA1C *t* tests, Wilcoxon rank sum tests, chi-square test, generalized estimating equations regression models	Primary health care	191	LHW in health care team	18	20
10	Moskowitz, D., Thom, D.H., Hessler, D., Ghorob, A., & Bodenheimer, T. (2013). Peer coaching to improve diabetes self-management: Which patients benefit most? *Journal of General Internal Medicine*, *28*(7), 938–942. San Francisco, USA	To examine the effect of peer health coaching on HbA1C modified by diabetes control characteristics	T2DM	RCT	HbA1C *t* tests, Fischer's exact test	Public health care	299	NR	6	18
11	Perez-Escamilla, R., Damio, G., Chhabra, J., Fernandez, M.L., Segura-Perez, S., Vega-Lopez, S., Kollannor-Samuel, G., Calle, M., Shebl, F.M., & D'Agostino, D. (2015). Impact of a Community Health Workers-Led Structured Program on Blood	To evaluate home-based culturally appropriate CHW-integrated T2DM counselling among Latino adults	T2DM	RCT	HbA1c, BG and lipid profile χ^2 test for categorical variables and independent samples ANOVA	Primary health care	148	Home visits	12 + 6	22

	Glucose Control Among Latinos With Type 2 Diabetes: The DIALBEST Trial. *Diabetes Care*, *38*(2), 197–205. Connecticut, USA				for continuous variables, a linear mixed effects					
12	Philis-Tsimikas, A., Fortmann, A., Lleva-Ocana, L., Walker, C., & Gallo, L.C. (2011). Peer-Led Diabetes Education Programs in High-Risk Mexican Americans Improve Glycemic Control Compared With Standard Approaches A Project Dulce Promotora Randomized Trial. *Diabetes Care*, *34*(9), 1926–1931. San Diego, USA	To evaluate the effect of a culturally sensitive diabetes self-management program among Mexican-American with T2DM	T2DM	RCT	HbA1C Multilevel models, within-group analysis	CHC	156	Learning class Support group Telephone calls	10 + 4	15
13	Prezio, E.A., Pagan, J,A., Shuval, K., & Culica, D. (2014). The Community Diabetes Education (CoDE) program: cost-effectiveness and health outcomes. *American Journal of Preventive Medicine*, *47*(6), 771–779. USA	To examine the long term cost effectiveness and improvements in diabetes-related complications	T2DM	RCT	HBA1c Archimedes model	NR	10 000’	NR	NR	15
14	Prezio, E.A., Cheng, D., Balasubramanian, B.A., Shuval, K., Kendzor, D.E., & Culica, D. (2013). Community Diabetes Education	To determine the impact of a culturally tailored diabetes education	T2DM	RCT	HbA1C *t* test to continuous	CHC	156	LHW appointments along with	12	23

	(CoDE) for uninsured Mexican Americans: a randomized controlled trial of a culturally tailored diabetes education and management program led by a community health worker. *Diabetes Research & Clinical Practice*, *100*(1), 19–28. Texas, USA	program for uninsured Mexican-American with DM			variables and Pearson χ^2 for categorical variables, linear mixed-models			usual care		
15	Rothschild, S.K., Martin, M.A., Swider, S.M., Tumialan Lynas, C.M., Janssen, I., Avery, E.F., & Powell, L.H. (2014). Mexican American trial of community health workers: a randomized controlled trial of a community health worker intervention for Mexican Americans with type 2 diabetes mellitus. *American Journal of Public Health*, *104*(8), 1540–1548. Chicago, USA	To assess whether community health workers could improve glycemic control among Mexican-Americans with diabetes	T2DM	RCT	DM empowerment, DM self-care Activities (also PA, nutrition), depression, stress scale, anxiety *t* test, Wilcoxon rank sum test, mixed effect linear model analysis.	Community setting	121	Telephone calls Home visits	24	25
16	Safford, M.M., Andreae, S., Cherrington, A.L., Martin, M.Y., Halanych, J., Lewis, M., Patel, A., Johnson, E., Clark, D.,	To test the effectiveness of peer coaches plus brief diabetes education	T2DM	RCT	HbA1c, systolic BP, LDL-C, BMI, and	Community setting	270	Meetings Telephone	10 + 5	23

	Gamboa, C., & Richman, J.S. (2015). Peer Coaches to Improve Diabetes Outcomes in Rural Alabama: A Cluster Randomized Trial. *Annals of Family Medicine*, *13*(S1), S18–S26. Alabama, USA	compares with brief education alone in Rural Alabama			quality of life Frequencies and *p* values			calls		
17	Spencer, M.S., Rosland, A.M., Kieffer, E.C., Sinco, B.R., Valerio, M., Palmisano, G., Anderson, M., Guzman, J.R., & Heisler, M. (2011). Effectiveness of a community health worker intervention among African American and Latino adults with type 2 diabetes: a randomized controlled trial. *American Journal of Public Health, 101*(12), 2253–2260. Detroit, USA	To test a culturally tailored CHW intervention for diabetes self-management improved diabetes clinical measures, self-management and distress among African American and Latino adults	T2DM	RCT	HbA1C, PA, nutrition Student *t* test, Pearson $\chi 2$ test	Community health center	136	Home visits Group classes Telephone calls	6	21
18	Tang, T.S., Funnell, M., Sinco, B., Piatt, G., Palmisano, G., Spencer, M.S., Kieffer, E.C. ,& Heisler, M. (2014). Comparative effectiveness of peer leaders and community health workers in diabetes self-	To compare a peer leader (PL) versus a community health worker (CHW) telephone intervention	T2DM	RCT	HbA1C Linear mixed methods, Student's *t* test, log-rank test, Fisher exact test,	Community setting	69	Group Classes Home visits Primary care provider visits	18	23

	management support: Results of a randomized controlled trial. *Diabetes Care*, 37 (6), 1525–1534. Detroit, USA	in diabetes self-management education			Pearson χ^2 test			Telephone calls		
19	Tang, T.S., Funnell, M.M., Sinco, B., Spencer, M.S., & Heisler, M. (2015). Peer-Led, Empowerment-Based Approach to Self-Management Efforts in Diabetes (PLEASED): A Randomized Controlled Trial in an African American Community. *Annals of Family Medicine*, *13*(S1), S27–S35. Michigan, USA	To investigate whether a peer support model could sustain improvements achieved in a short-term diabetes self-management education program for African American adults with type 2 diabetes	T2DM	RCT	HbA1C Linear mixed model, Spearman correlation, Student's *t* test, log rank test, Fisher's exact test, Pearson's $\chi 2$	Community setting	64	Group sessions Face to face meetings Telephone calls	15	25
20	Thom, D., Ghorob, A., Hessler, D., DeVore, D., Chen, E., & Bodenheimer, T.A. (2013). Impact of peer health coaching on glycemic control in low-income patients with diabetes: A randomized controlled trial. *Annals of Family Medicine*, *11*(2), 137–144. San Fransisco, USA	To test the impact of individual peer coaching on glucose control on patients with poorly controlled diabetes	T2DM	RCT	HbA1C Linear mixed model, logistic regression	Public clinics	275	In person interactions Telephone calls	6	20

21	van der Wulp, I., de Leeuw, J.R.J., Gorter, K.J., & Rutten, G.E.H.M. (2012). Effectiveness of peer-led self-management coaching for patients recently diagnosed with Type 2 diabetes mellitus in primary care: a randomized controlled trial. *Diabetic Medicine*, *29*(10), e390–e397. Netherlands	To study the effectiveness of a self-management coaching intervention in recently diagnosed patients with Type 2 diabetes	T2DM	RCT	Self-efficacy, coping, physical activity, dietary habits, psychological well-being, depressive symptoms and diabetes related distress Analysis of variance	General practices	119	Home visits Telephone calls Emails	18	22
22	Whittle, J., Schapira, M.M., Fletcher, K.E., Hayes, A., Morzinski, J., Laud, P., Eastwood, D., Ertl, K., Patterson, L., & Mosack, K.E. (2014). A randomized trial of peer-delivered self-management support for hypertension. *American Journal of Hypertension*, *27*(11), 1416–1423. Milwaukee, USA	To compare changes in BP control among veterans participating in a peer-delivered vs. Professionally delivered health education intervention	CVD (Hyper-tension)	RCT	Systolic BP Mixed model, generalized linear model	Veterans' service organizations	379	Group sessions	12	24
23	Assah, F.K., Atanga, E.N., Enoru, S., Sobngwi, E., & Mbanya, J.C. (2015).	To examine the effectiveness of a	T2DM	Trial	HBA1C, BP, blood lipids, BMI, waist	Communit	192	Group	6	17

	Community-based peer support significantly improves metabolic control in people with Type 2 diabetes in Yaounde, Cameroon. *Diabetic Medicine*, *32*(7), 886–889. Cameroon	structured peer support diabetes intervention in Cameroon		circumference, diabetes self-care (also PA and nutrition) Continuous variables and differences, Student *t* test	y setting		meetings Personal encounters Telephone calls		
24	Carey, M.E., Mandalia, P.K., Daly, H., Gray, L.J., Hale, R., Stacey, L.M., Taub, N., Skinner, T.C., Stone, M., Heller, S., Khunti, K., & Davies, M.J. (2014). Increasing capacity to deliver diabetes self-management education: Results of the DESMOND lay educator non-randomized controlled equivalence trial. *Diabetic Medicine*, *31*(11), 1431–1438. England and Scotland	To develop and test a format of delivery of diabetes self-management education by paired professional and lay educators	T2DM	trial	Diabetes coherence, diabetes perception Intra-class-correlations, continuous and categorical variables, *t* test, χ^2, Wilcoxon test	Primary health care	242	Group meeting	1 day	20

25	Castillo, A., Giachello, A., Bates, R., Concha. J., Ramirez, V., Sanchez, C., Pinsker, E., & Arrom, J. (2010). Community-based diabetes education for Latinos: The Diabetes Empowerment Education Program. *Diabetes Educator*, *36*(4), 586–594. California, USA	To test the feasibility and effectiveness of a linguistic and culturally appropriate diabetes education program among Latinos	T2DM	trial	HbA1C, PA, nutrition Frequency tables and cross-tabulations, *t* tests, χ^2 tests	Community setting	47	Group meeting Group and individual activities	2.5	15
26	Cene, C.W., Haymore, L.B., Ellis, D., Whitaker, S., Henderson, S., Lin, F.C. & Corbie-Smith, G. (2013). Implementation of the power to prevent diabetes prevention educational curriculum into rural African American communities: A feasibility study. *The Diabetes Educator*, *39*(6), 776–785. North Carolina, USA	To describe the feasibility of using a community-based approach to implement a diabetes prevention education curriculum in rural African-American settings	T2DM	Trial	BG, BP, BMI, PA Mc Nemar test, *t* test	Community setting	30	Small group sessions	7.5	11
27	Collinsworth, A.W, Vulimiri, M., Schmidt, K. L., & Snead, C.A. (2013). Effectiveness of a community health worker–led diabetes self-management education program and implications for CHW involvement in care	To evaluate the effectiveness of a diabetes self-management education program and to	T2DM	Trial	HBA1C, BMI, Blood pressure *t* test	Community clinic	497	Group meetings Clinical assessments	12	12

	coordination strategies. *The Diabetes Educator*, *39*(6), 792–799. Dallas, USA	understand how CHWs and primary care providers work together								
28	DePue, J.D., Rosen, R., Seiden, A., Bereolos, N., Chima, M., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S.T. (2013). Implementation of a culturally tailored diabetes intervention with community health workers in American Samoa. *The Diabetes Educator*, *39*(6), 761–771. American Samoa, USA	To investigate a primary care–based, nurse–community health worker (CHW) team intervention to support type 2 diabetes self-management in American Samoa	T2DM	Trial	HBA1C, BP, smoking status, alcohol use, depression score, treatment dose ANOVA, Tukey's post hoc test, nonparametric comparison of medians, χ^2-tests	Primary care	104	Group visits Individual visits	12	16
29	Dye, C., Williams, J., & Hoffman Evatt, J. (2015). Improving hypertension self-management with community health coaches. *Health Promotion Practice*, *16*(2), 271–281. Appalachians, USA	To improve hypertension self-management among rural residents older than 60 years through education and support	CVD (Hyper-tension)	Trial	Hypertension knowledge and self-management, BP, weight, waist circumference, blood lipids and	Community setting	146	Group classes Education program	4	20

					BG, PA, nutrition Student *t* test, McNemar's test, Bonferroni correction					
30	Fernandes, R., Braun, K., Spinner, J., Sturdevant, C., Ancheta, S., Yoshimura, S., Compton, M., Wang, J-H., & Lee, C. (2012). Healthy heart, healthy family: A NHLBI/HRSA collaborative employing community health workers to improve heart health. *Journal of Health Care for the Poor and Underserved*, *23*(3), 988–999. Hawaii, USA	To evaluate the impact of the heart health curriculum on low-income Filipinos with CVD risk factors in Hawaii	CVD	Trial	Disease and medication histories, BMI, waist circumference, BP, BG, lipid profile, HBA1C, PA, nutrition *t* tests, chi-squared	Community setting	92	Group sessions	12	16
31	Islam, N., Wyatt, L., Patel, S., Shapiro, E., Darius Tandon, S., Runi Mukherji, B., Tanner, M., Rey, M.J., & Trinh-Shevrin, C. (2013). Evaluation of a community health	To explore the impact and feasibility of a pilot intervention to improve diabetes management	T2DM	Trial	HBA1C, weight, nutritional and physical activity behaviors, access to	Clinical and community setting	26	Group sessions Individual	9	20

	worker pilot intervention to improve diabetes management in Bangladeshi immigrants with type 2 diabetes in New York City. *The Diabetes Educator*, *39*(4), 478–493. New York, USA	among Bangladeshi-American individuals with type 2 diabetes living in New York City			health care, diabetes knowledge, self-management, self-efficacy, mental health Fisher's exact test, *t* test, frequencies, means, standard deviations			visits		
32	Lorig, K., Ritter, P.L., Plant, K., Laurent, D.D., Kelly, P., & Rowe, S. (2013). The South Australia Health Chronic Disease Self-management Internet Trial. *Health Education & Behavior*, *40*(1), 67–77. South Australia	To implement and investigate the effectiveness of a chronic condition self-management internet trial in South Australia	CC	Trial	Pain/physical discomfort, shortness of breath, tiredness, impact of disease, health distress, self-rated disability, number of illness days, PA Paired *t* tests	Online-based, community setting	194	Interactive web program	1.5 + 12	21

33	Micikas, M., Foster, J., Weis, A., Lopez-Salm, A., Lungelow, D., Mendez, P., & Micikas, A. (2015). A Community Health Worker Intervention for Diabetes Self-management Among the Tz'utujil Maya of Guatemala. *Health Promotion Practice*, *16*(4), 601–608. Guatemala	To investigate the effectiveness of a structured, community-led diabetes self-management intervention among the Tz'utujil Maya of Guatemala	T2DM	Trial	Health beliefs, practices, HbA1c, BMI, PA *t* tests	Community setting	52	Individual visits at clinics and home Group sessions	4	14
34	Otero-Sabogal, R., Arretz, D., Siebold, S., Hallen, E., Lee, R., Ketchel, A., Li, J., & Newman, J. (2010). Physician-community health worker partnering to support diabetes self-management in primary care. *Quality in Primary Care*, *18*(6), 363–372. San Francisco, USA	To improve self-management among patients with type 2 diabetes	T2DM	Trial	HbA1c, LDL, BP and total cholesterol, Patient Activation Measure Frequencies, cross tabulations, *t* test comparisons	Primary care	114	Participant visits.	24	9
35	Ryabov, I. (2014). Cost-effectiveness of Community health workers in controlling diabetes epidemic on the US-Mexico border. *Public Health*, *128*(7), 636–642.	To evaluate clinical outcomes and long-term cost-effectiveness of T2DM intervention among Mexican-	T2DM	Trial	HbA1c, total cholesterol, HDL, triglycerides, BP, BMI	Community setting	30	Individual visits Telephone contacts	24	13

	Texas, USA	Americans								
36	Ryabov, I. (2011). The impact of community health workers on behavioral outcomes and glycemic control of diabetes patients on the U.S.-Mexico border. *International Quarterly of Community Health Education, 31*(4), 387–399. Texas, USA	To determine the impact of CHW on the self-management practices of people in with diabetes on the US–Mexico border	T2DM	Trial	DM knowledge	NR	30	NR	24	12
37	Saxe-Custack, A., & Weatherspoon, L. (2013). A patient-centered approach using community-based paraprofessionals to improve self-management of Type 2 Diabetes *American Journal of Health Education*, *44*(4), 213–220. Michigan, USA	To examine if a lifestyle management program can initiate positive impacts on self-management and behavior change among participants with type 2 diabetes	T2DM	Trial	BP, BMI, HbA1c, demographic information, lifestyle behaviors (also PA and nutrition), behavior change by stages of change, appraisal of diabetes Paired *t* tests	Communit y setting	122	Group sessions Individual meetings Home visits	2.5+6	16
38	Tsoh, J., Burke, N., Gildengorin, G., Wong,	To evaluate a smoking	CC	Trial	7-day and 30-day	Communit	192	Small group	2+3	21

	C Le, K., Nguyen, A., Chan, J.L., Sun, A., McPhee, S.J. & Nguyen, T.T. (2015). A Social network family-focused intervention to promote smoking cessation in Chinese and Vietnamese American male smokers: A feasibility study. *Nicotine & Tobacco Research, 17*(8), 1029–1038. USA	cessation program: intention to quit, use of cessation recourses and smoking abstinence	(smoking cessation)		smoking abstinence, assessed by smokers and family members Descriptive statistics, significance, linear model adjustment	y setting		sessions Telephone calls		
39	Tully, M., Kos, A., Eastwood, D., Kusch, J., & Kotchen, T. (2015). Implementation of an adjunct strategy to reduce blood pressure in blacks with uncontrolled hypertension: a Pilot Project. *Ethnicity & Disease*, *25*(2), 168–174. Wisconsin, USA	To describe the development, implementation, and evaluation of a BP program	CVD (blood pressure)	Trial	BP *t* tests and χ^2tests.	Health center	83	Group sessions	6	16
40	Turner, A., Anderson, J.K., Wallace, L.M. & Bourne, C. (2015). An evaluation of a self-management program for patients with long-term conditions. *Patient Education and Counseling*, *98*(2), 213–219. UK	To investigate a self-management program among patients with long-term conditions	CC	Trial	Demographic data, Patient Activation, EuroQol, Hospital Anxiety and Depression, Health Education Impact	Communit y setting	486	Group meetings	2	19

		Questionnaire Paired *t* tests, General linear model, and analysis of covariance, McNemar's test

NR = not reported

CVD = cardiovascular disease

CC = chronic conditions or its prevention

CHC = community health center

‘=estimated

BMI = body mass index

BP = blood pressure

BG = blood glucose

Characteristics and training of LHWs			Theories and guidelines behind the intervention
	Self-management intervention components and delivery by LHWs		
Experience with long-term conditions			National guidelines for DM, hypertension and cardiovascular diseases
Eligibility based on personal interest or maintained self-management	Participants recruited by LHWs or health professionals	Interaction frequency from once a week to every second month, often besides usual health care	Transtheoretical model of change
Length of training from one day to 240 h, approx. 30 to 60 h	Attrition prevention by providing, e.g., make-up sessions, telephone support calls, gift cards.	Principles of implementation: individual-empowering, culture and language sensitiveness, peer education, family-centering, social networking	Social cognitive theory
Elements of training: classroom training, hands-on activities, home visits, clinical measurements	Elements: PA, nutrition, medication, clinical measurements, and other education classes; online programs	BCTs: Self-monitoring, goal setting, information providing, action plans, enhancing social support	Chronic care model
Training contents: LTCs, motivation, self-monitoring, self-management, medication	Formats: Individual or group meetings delivered by a LHW or a group of LHWs; LHW as a	provided face to face, via telephone, online, at clinics or community centers or home visits.	Self-efficacy theory

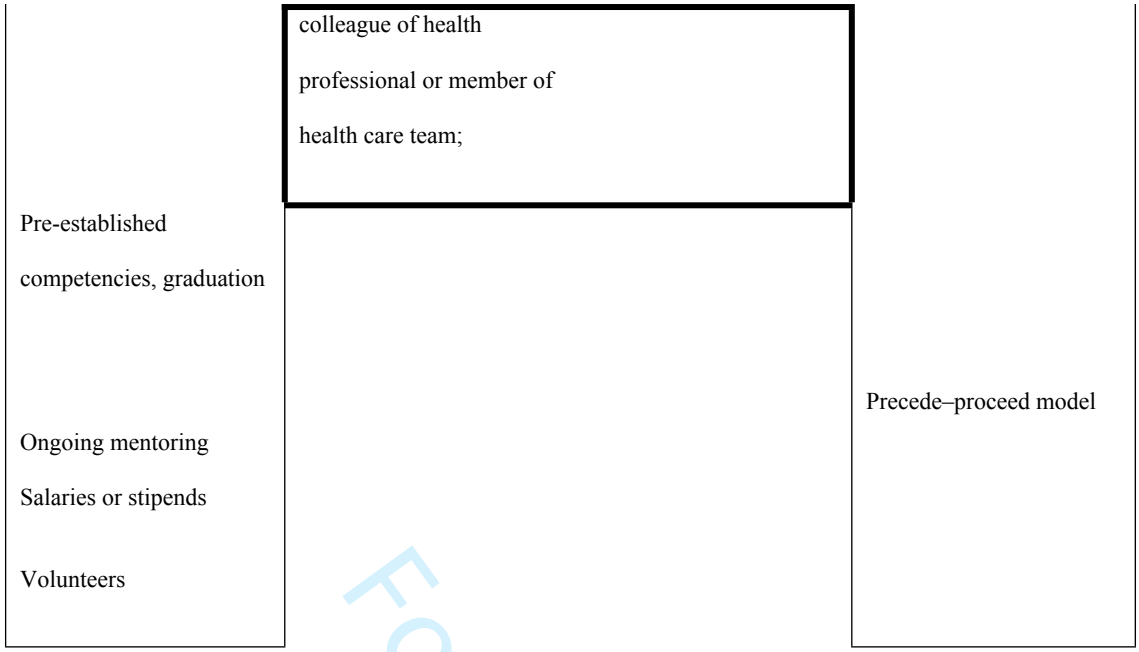

Figure 2. Synthesis of LHW-led self-management interventions for diabetes, cardiovascular diseases and prevention.

Table 4. Reported theories and principles.

Theories and models applied and reported	***n***
Transtheoretical model of change[7,8,11,23,29,30,33,37,38]	9
Social cognitive theory[1,8,14,21,38]	5
Chronic care model[22,40]	2
Self-efficacy theory[31,32]	2

Precede–proceed model[2,28]	2
Socioecological model[5,17]	2
Health belief model[33]	1
Self-management theory[15]	1

Principles and methods applied and reported	***n***
Individual-empowerment[17–19,23,25,33,34,38–40]	10
Peer education principles[4,8,9,23,32,39,40]	7
Culture-sensitivity[11,12,14,23,33,34]	6
Understanding of the context in which behavior changes take place[4,8,21,23,33,30]	6
The active role of recipients[4,12,25]	3
Motivational interview[25,30,37]	3

Table 5. Examples of the most often reported BCTs.

BCT	***n***
Self-monitoring[3,4,6–8,12–14,16,18,19,21,22,25,27–32,37,39]	24
taking clinical measurements: blood sugar and blood pressure[2,6,15,16,19,28,30,39]	
monitoring of symptoms and health behavior related to the	

assessed goals[4,7,28,29]	
using self-management monitors: blood glucose, blood pressure and pedometers [12,14,22,29,30,39]	
Goal setting[3,7,8,15,16,18–20,21,25,27–29,32–34,35,37,38]	20
Information providing[6,8,11,14,15,17,19,21,22,25,28,30–32]	17
Individual action plans to support health-related behavior[6,10,11,14,19,20,29,31–33,38,39]	12
Enhancing participants' social support[6,7,15,16,18,22,23,25,29,32,40]	11
Practicing problem solving techniques[2,6,7,15,18,19,28,29,32,37]	10
Possibilities to tailor intervention activities towards participants' personal needs[11,14,18,28,30,31,33,38–40]	10

Table 6. Original studies that reported outcomes of NB and/or PA

Original paper	Theory	Format	Individual / Group	Additional info	Number of BCTs	Frequency	Length + follow-up (month)	Improvement in NB	Improvement in PA	Improv-ment in CM
(7) Lynch et al., 2014	Models of behavior change	Telephone calls Education lectures	Individual + group	18 group sessions by dietitian and LHW weekly for three months, afterwards every second week; phone calls weekly by LHW	9	weekly	6	yes	yes	yes / no
(15) Rothschild et al., 2014	Self-management theory	Home visits Telephone calls	Individual	36 home visits	7	monthly	24	no	no	yes / no
(17) Spencer et al., 2011	Empowerment theory	Education lectures, Home visits, Accompanied clinic	Individual	Group session once every two weeks Telephone calls once	4	weekly	6	no	yes	yes / no

		visits, Telephone counselling, Peer activities		every two weeks						
(21) van der Wulp et al., 2012	Social cognitive theory	Home visits, Education lectures, Telephone counselling, Emails	Individual	Monthly meetings, Telephone calls two weeks after meetings. Plus calls and emails when needed.	5	two weeks	18	yes	no	-
(23) Assah et al., 2015	Socioculturally adapted community-based approach	Group meeting, Individual appointments, Telephone counselling, Home visits	Individual + group	Six group meetings, personal encounters, telephone calls (five calls)	3	monthly	6	yes	yes	yes

(25) Castillo et al., 2010.	Empowerment theory, Adult education	Group meeting, Individual appointments, Education lectures	Individual + group	Ten group education sessions + individual contacts between sessions	9	weekly	2.5	yes	yes	yes / no
(26) Cene et al., 2013	Community capacity building	Group meeting, Education lectures	Group	Group meetings weekly for six weeks, then monthly,12 sessions total	2	six times weekly, afterwards monthly	7.5	-	no	no
(29) Dye et al., 2015	Transtheoretical model of change	Group meeting, Education lectures	Group	Self-management curriculum: 7 meetings plus additional lectures on NB or PA	8	weekly	4	yes	yes	yes
(30) Fernandes et al., 2012	Transtheoretical model of change	Group meeting, Education lecture, Peer work shop	Group	Group meetings, afterwards monthly meetings up to 12 months	9	11 times weekly, afterwards monthly	12	yes	yes	yes / no

(31) Islam et al., 2013	Community-based approach	Group meeting, Individual appointments, Education lectures, Make-up sessions	Individual + group	six monthly group meetings plus individual meetings at months 3, 6, and 9	4	monthly up to 6 months, individual at 9 months	9	yes	yes	no
(32) Lorig et al., 2013	Self-efficacy theory	Online group meetings, Education lectures, Weekly activities	Online: Individual + group	Online program	15	available every day	1.5 + 12	-	yes	-
(33) Micikas et al., 2015	Stages of change, Health belief model	Group meetings, Education lectures, Home visits	Individual + group	Individual home visits, group meetings	7	weekly	4	-	no	yes
(37) Saxe-Custack et al., 2013	Community-based approach	Group meetings, Individual appointments,	Individual + group	four individual weekly meetings at home, afterwards six home	9	weekly	2.5 + 6	yes	no	yes / no

	Education lectures,	visits or group meetings
	Home visits	weekly

NB = nutrition behavior

PA = physical activity

CM = clinical measurements

- = was not measured

Table 7. Outcomes in nutrition behavior and physical activity and their links to intervention components and clinical measurements

Measured outcome	Type of effect	Original paper	Formats	BCTs	Clinical measurements +improvement –no improvement
NB + PA	NB + PA improved	7	Telephone calls + Education lectures	9: Goal setting, motivating, emotional support, teaching problem-solving techniques, enhancing social support, self-monitoring, role	+HbA1C

		(individual + group)	model narratives, hands-on activities, taking and monitoring clinical measurements	+Weight loss -Blood lipids -Blood pressure
	23	Group meeting + Individual appointments + Telephone counselling + Home visits	3: Teaching self-management skills, enhancing social support, discussion	+HbA1C +Blood lipids +Blood pressure +BMI +Fast BC +Waist circ +Weight loss
	25	Group meeting + Individual appointments + Education lectures	9: Goal setting, self-efficacy support, motivating, teaching self-management skills, enhancing social support, support decision making, information providing, self-monitoring, hands-on activities	+HbA1C +Blood pressure -Weight loss
	29	Group meeting + Education lectures (group)	8: Goal setting, self-efficacy support, teaching problem-solving techniques, enhancing social support, action plans, self-monitoring, personal health diary, taking and monitoring clinical measurements	+Blood pressure +Fast BC +Weight loss +Blood lipids

	30	Group meeting + Education lectures (group) + peer work shop	9: Information providing, self-monitoring, using written counselling materials, reminders, tailoring, hands-on exercises, taking and monitoring clinical measurements, healthy snacks, incentives	+Blood lipids +Fast BC -HBA1c -Blood pressure -BMI
	31	Group meeting + Individual appointments + Education lectures + Make-up sessions	4: Information providing, action plans, self-monitoring, tailoring	-Blood lipids -HbA1c -Blood pressure -BMI
	21	Home visits + Education lectures + Telephone counselling + emails	5: Goal setting, self-efficacy support, motivating, information providing, self-monitoring	NR
NB improved	37	Group meetings + Individual appointments + Education lectures + Home visits	9: Goal setting, motivating, teaching problem solving, teaching relapse prevention, information providing, self-monitoring, tailoring, guest speakers, hands-on exercises	+HbA1C +BMI -Blood pressure
PA improved	17	Education lectures + Home visits + Accompanied clinic visits	4: Self -efficacy support, keeping appointments, information providing, hands-on exercises	+HbA1C +Blood lipids

					-Blood pressure -BMI
	no improvements	*15*	*Home visits + Telephone calls*	*7: Goal setting, teaching self-management skills, teaching problem-solving techniques, enhancing social support, information providing, using metaphors, taking and monitoring self-management skills*	*+HbA1C* *+Weight loss* *-Blood lipids* *-Blood pressure*
	improved	32	Online group meetings + Education lectures + Activities	15: Goal setting, self-efficacy support, teaching self-management skills, emotional or behavioral support, teaching problem-solving skills, sharing feelings, enhancing social support, stress managements, information providing, action plan, self-monitoring, feedback, discussion, role model narratives, hands-on exercises	NR
PA	*no improvements*	*26*	*Group meeting + Education lectures*	*2: Guest speakers, taking and monitoring clinical measurements*	*-Blood pressure* *-Fasting BC* *-Weight loss* *-Blood lipids* *-HbA1C*
		33	*Group meetings + Education lectures + Home visits*	*7: Goal setting, emotional and behavioral support, action plans, reminders, discussion, tailoring, hands-on exercises*	*+HbA1C*

Identification: Studies from Electonic Searches (*n* = 1380)

MEDLINE 154

PsycINFO 711

CINAHL 95

Cochrane 29

Web of Science 391

Exclusion with reasons (*n* = 1017)

-discussion papers with no study results

-study protocols

-LHWs as informants

Eligible titles (*n* = 363)

MEDLINE 106

PsycINFO 144

CINAHL 49

Cochrane 3

Web of Science 61

Exclusion with reasons (*n* = 217)

-informants adolescents, children or LHWs

-no outcomes in self-management or self-care

Eligible abstracts (*n* = 146)

MEDLINE 45

PsycINFO 46

CINAHL 27

Cochrane 2

Web of Science 26

Exclusion with reasons

- Duplicate papers (*n* = 49)

-Mental health (*n* = 14)

-Antiretroviral infections (*n* = 7)

-Parent program (n = 4)

-Asthma or pulmonary (*n* = 3)

-Cancer (*n* = 3)

-Other non-diabetes or non-heart and circulation (*n* = 6)

-Qualitative studies (= 6)

-Reviews (*n* = 7)

-Papers without or only baseline data (*n* = 7)

Included to full text and quality analysis (*n* = 40)

-Diabetes (*n* = 29)

-Cardiovascular diseases (*n* = 8)

-Risk of cardiovascular diseases (*n* = 3)